

hello welcome to the lecture on fundamental principles of organic chemistry and some techniques i am professor shankar raman from the department of chemistry iit madras in the first lecture of a series of lectures that i would like to give in organic chemistry today we will discuss some fundamental aspects such as hybridization in organic chemistry to start with let us define what organic chemistry is all about organic chemistry is a very fascinating subject in chemistry it is a subset of chemistry it deals with compounds of carbon

So essentially you can define organic chemistry as chemistry of carbon compounds carbon not only forms bonds with itself in forming long chains of hydrocarbon for example the first member of the hydrocarbon is methane the second member is ethane where the two carbons are bonded to each other the structure should be like this then go to the next homologous series you have propane butane pentane and

So on

So carbon has the ability to form carbon carbon bonds quite elaborately

So much

So that the polymer polyethylene is a linear chain of C_2H_4 where the C_2H_4 hundreds of them are connected together i will just put n here n can be 100 120 150 and

So on

So carbon is capable of forming such long chain hydrocarbons such as polyethylene for example it also forms compounds with other elements of the periodic table with hydrogen nitrogen sulfur oxygen phosphorus and halogens

So where the carbon is directly attached to nitrogen sulfur phosphorus halogen they are all considered to be organo organic compounds now organic chemistry is essentially a life sustaining chemistry in the world of biology if you look at biological molecules like dna for example proteins carbohydrates lipids and

So on they are all organic compounds organic molecules

So one can call for example dna proteins carbohydrates lipids in other words fat now these are polymeric compounds that are available in nature from biological systems and all of them belong to the category of organic compounds not only that these organic molecules are essential for the sustenance of life they occur very widely in nature early on during the mid of eighteenth century there was a theory called vital force theory this was proposed by a scientist by name berselius he was a swedish scientist in 1780 versilius proposed the theory called the vital force theory now according to this theory if you want to make an organic compound you have to have a living system like a plant or an animal and

So on the reason for believing such a theory is that early on during the development of organic chemistry organic molecules were typically isolated from nature what do i mean by nature the organic compounds were isolated from plant material or from animals or from living organisms for example and such a theory had the support from the isolation of the material from nature where the living creatures created the organic compounds

So the vital force theory was believed to be in existence for several decades originally proposed from 1780 by brazilians until eighteen twenty eight another scientist came along by the name frederic schwoller he sort of did an experiment which amount to disproving the concept that a living organism is necessary for producing organic compounds this is a very path breaking experiment very important experiment in organic chemistry experiment itself is essentially taking ammonium chloride which is an inorganic substance there is no carbon present in the system then taking potassium cyanide which is also an inorganic salt for example mixing together you get ammonium cyanide ammonium cyanide is also a ionic inorganic compound and what volar did was to heat this compound the molecule this compound undergoes a rearrangement reaction in producing a molecule known as urea urea is considered to be an organic compound this was the first lab synthesized organic compound So that was a blow to the

So called the vital force theory because now it is possible to generate an organic compound from purely inorganic substances inorganic substances are typically substances which are obtained from minerals from earth's crust for example

So they do not need a life form to generate inorganic molecules such an inorganic molecule is heated and converted into an organic molecule in the laboratory for the first time which gave the vital blow to the it gave the blow to the vital force theory as proposed by bersilius since then organic chemists are involved in synthesis of organic compounds let us define organic synthesis this is essentially making organic compound in the laboratory without the involvement of any kind of microorganism or a living matter

for example where laboratory techniques are used for producing organic compound is called organic synthesis by mid 19th century organic chemistry is a developed subject organic chemistry is only about 200 to 225 years old right now it is a full fledged part of chemistry and it is a fully developed aspect of chemistry at the present time in addition to twenty eight synthesis of the urea by olar in eighteen forty five coal bay synthesized acetic acid in the laboratory this is the first time acetic acid was synthesized in the laboratory acetic acid was called vinegar which was obtained from natural sources for example however for the first time in the laboratory synthesis of acetic acid was demonstrated by coal in eighteen fifty six bertha lot synthesized methane from aluminum carbide aluminium carbide upon hydrolysis gives methane again a laboratory synthesis of an organic compound from what is considered to be an inorganic substance namely the aluminium carbide which is an ionic inorganic substance

So the original belief that vital force is necessary for synthesis of organic compound has been disproved by several of this kind of synthesis by the mid 19th century or So and currently organic synthesis is a very well established discipline of chemistry one can synthesize simple molecules like for example aspirin to very complex molecules like a steroid molecule in the laboratory without the involvement of any kind of a living microorganism or living plant or such materials now organic chemistry is applicable in for example in medicines in food in clothing and in fuels for example medicines such as for example simple compound like aspirin which is a structure that is shown here this is acetyl salicylic acid and that is called aspirin it is a headache medicine this is an organic compound ibuprofen for example is an organic compound this is ibuprofen for example naproxen ibuprofen aspirin paracetamol for example they are all organic compounds used in a day to day medicine starch is an organic compound which is a major constituent of rice and other grains for example which is a source of this is a class of compounds known as carbohydrates these are the source of energy clothing for example nylon polyester even cotton which is available in nature for example is a form of organic compound they are all polymeric material nevertheless they are organic compounds fuels for example gasoline petrol diesel they are all hydrocarbon compounds organic compounds So it essentially shows that organic compound essentially is present everywhere around you

So organic chemistry is a very important subject not only for life sustenance it is also important in biology in terms of the kind of molecules that one deals with in biochemistry for example

So till now what i have been trying to impress upon is the importance of organic chemistry and the kind of theories that existed which were later on disproved by means of other scientists for example now we will go into shapes of organic molecules in organic chemistry organic molecules can be either three dimensional two dimensional or one dimensional depending upon the kind of carbon that we are dealing with let us start with the simple molecule methane methane has four hydrogens that are attached to a carbon and one adder in order to explain the size and shape of methane one invokes the theory of hybridization before we go into hybridization let us for the sake of argumentative purposes write methane in two different formats this is one structure of methane one can write in this particular this particular structure the carbon is connected to four hydrogen and all the hydrogens as well as carbon are in one plane which is the plane of the black board in other words this is a square planar of methane i am not saying this is a right structure but there is a possibility that one can have the square planar structure alternatively one can consider for example the hydrogen carbon and hydrogen to be in one plane

So these three atoms are in one plane the third hydrogen is behind the plane of the black board and the fourth hydrogen is in front of the plane of the black board this is another structure of methane this is called the tetrahedron structure until the early 20th century the structure of methane was known or the tetrahedral carbon of methane was known it is by two scientists went hof and label is a dutch scientist and lebel is a french scientist independently during the early 1900s they simultaneously proposed to the carbon of a hydrocarbon to be tetrahedral in shape they had their own reasons based on stereochemistry of organic compounds which we will deal with later nevertheless this was a path breaking discovery in terms of the proposal that a saturated carbon should have a geometry of this kind and not a geometry of this kind where you have square planar now what is the difference between these two structures this is a two dimensional structure it is confined to a plane whereas this is a three dimensional structure if you want to

understand this particular structure this hydrogen carbon and this hydrogen they lie on the plane of the black board whereas this carbon hydrogen bond is protruding inside the plane of the black board whereas this carbon hydrogen is projecting outside the plane of the black board the same thing can be represented by means of a tetrahedral arrangement of carbon in this particular fashion again indicating for example this carbon hydrogen bond to be inside and this carbon hydrogen bond to be outside the plane of the black board this is say forming a tetrahedron if you can see clearly here

So the in the tetrahedron this carbon is at the center of the tetrahedral arrangement and the four hydrogens are occupying the four vertices of the tetrahedral structure because all the four hydrogens are equal this is a symmetrical tetrahedral structure as opposed to a distorted tetrahedron if one of the hydrogen were to be replaced by a chlorine for example all the carbon hydrogen bonds are equal and all the carbon hydrogen hydrogen angles are also equal this angle if you look at this will be 109 degrees 54 minutes similarly this will be 109 degrees 54 minutes this will be 109 54 minutes similarly this also 109 degrees 54 minutes in the 3 dimensional aspect on the other hand if you look at this structure this will be only 90 each of this will be only 90 because this is a planar structure that would mean that this carbon hydrogen bond and this carbon hydrogen bond will be closer together in comparison to the carbon hydrogen bonds in this particular structure and this is precisely for the reason that this structure can be discarded because if a carbon hydrogen bonds can be having a larger angle if they can be further away the bonding electron electron repulsion can be minimized in this particular structure in comparison to this particular structure here now this is the structure of methane which is tetrahedral in nature we can explain the formation of the tetrahedral carbon or the trigonal carbon or an sp kind of a carbon using the principle of hybridization what is hybridization it is a fairly simple concept you take a set of atomic orbitals mix them together and redistribute them in certain orientation this is called hybridization

So essentially one can write this as mixing of atomic orbitals and redistribution of the orbitals in specific orientations this is called the hybridization process now in order to do the hybridization there are certain rules that one needs to follow conditions for hybridization are one can only hybridize orbitals in valency cell in other words only the outer most electrons which are capable of undergoing bonding interaction with other atoms are capable of undergoing hybridization orbitals undergoing hybridization should be close in energy when you say it is the valence shell electrons are the orbitals which can undergo hybridization the orbitals has to be close in energy for example you cannot take a one s electron and a two p electron and hybridize on the other hand you can take a two s electron and a two p electron and do a hybridization because they are closer in energy these are widely separated in energy whereas these are closer in energy

So this can lead to hybridization like the sp hybridization sp² hybridization and sp³ hybridization whereas this cannot undergo hybridization because they are vastly different in their energy in terms of the relative energies now for the hybridization to occur one need not promote an electron from one orbital to another orbital this i will explain it in a minute motion of electron from one orbital to another orbital is not an essential condition for hybridization both filled orbital and half filled orbital can undergo hybridization

So these are essential conditions for hybridization to take place once the hybridization takes place what is the outcome of the hybridized molecular orbital the first one is number of atomic orbital that is hybridized this will be equal to the number of hybridized orbital obtained after hybridization in other words you start with three molecular three atomic orbitals you will end up with three hybridized orbital that is what it essentially means all hybridized orbitals will have same size shape and energy in other words if you have taken four atomic orbital and hybridized to produce four hybridized orbital all the four hybridized orbitals will have the same shape as well as energy and size in terms of the redistribution hybridized orbital point or orient in specific direction depending on the in other words the hybridized orbital has very specific orientation in space that orientation essentially dictates the shape of the molecule that is formed by certain hybridization for example if we say sp³ hybridization it is a tetrahedral geometry sp² hybridization it is a trigonal geometry and sp hybridization it will be a linear geometry and

So on

So these are some things one need to remember the conditions for hybridization is

essentially very simple only orbitals in the valence shell can undergo hybridization orbitals supposed to be close in energy you cannot take for example one s orbital with the two p or three p orbitals and hybridize them together because they are vastly different in energy you can take two s and two p orbitals which are close in energy in order to do the hybridization if the orbital is a filled up orbital it is not necessary to promote the electron to an empty orbital in order to do hybridization

So one can do with both filled orbital as well as half filled orbital can undergo hybridization to produce hybridized orbitals for example the outcome of the hybridization essentially is that if you take n number of atomic orbital and hybridize them you will get exactly the same number of hybridized orbitals also all the hybridized orbitals will have same shape and identical energy in other words this is called degenerate orbitals degenerate orbitals essentially means they have identical energy in terms of the energy of the orbital is concerned hybridized orbitals actually orient in a very specific direction in space depending upon the hybridization the orientations will be different and that is what gives the definitive shapes for organic molecules having said this now let us look into the concept of hybridization in a little more detailed manner to

understand hybridization one needs to understand carbons electronic configuration carbon has an electronic configuration of one s two two s two and two p two in other words in the valence shell carbon has four electrons two of them in the s orbital and two of them in the p orbital and that is what gives the four valency of carbon tetra valency carbon if you want to draw the box diagram for the electrons this is according to the huns rule of maximum multiplicity they should be parallel with respect to each other

So this is one f orbital two s orbital and two p x y z orbitals now if you take the s orbital and the p orbital you can combine them together and hybridize them to give s p three hybridized orbital in other words the two s orbital of carbon and the 2px 2py and 2pz orbitals of carbon are mixed together and hybridized to give hybridization what is known as sp³ hybridization indicating that the hybridization involves one of the s orbitals namely the two s orbital and three of the p orbitals which are the p x p y and p is orbitals

So you have taken four orbitals atomic orbitals

So that should end up with four hybridized orbitals this is one of the rules of the hybridization if you start with n number of atomic orbitals you will end up with n member of hybridized orbital now the orientation of the s p three hybridized orbital is important first of all let us look at the shape of the s p three hybridized orbital

So if you were to draw the cartesian coordinates of the x y z axis for example the one s electron is spherical

So one can draw the one s electron in this particular fashion this is x y and z the p orbital has a dumbbell shaped in other words the p orbital has a shape like this one for example this is what is known as the dumbbell shape of p orbital

So the p x orbital will be having a orientation this particular manner similarly the p y will have a orientation along the y or y axis of the cartesian coordinate and finally the said will also have orientation along the z axis of this particular shape

So if you combine all of these things you get the sp³ hybridization you start with four atomic orbital one two s orbital and three p orbital namely p x y z orbital the resulting s p three hybridized carbon has orientation in such a manner the initially the hybridized orbitals have different shape once the hybridization is over the hybridized orbital has a shape which is this like this only one lobe with a small lobe that is present at the end of the narrow end of the lobe that we have here

So this will be the shape of the sp three hybridized orbital for example

So there are four s p three hybridized orbital let us consider the orientation of the four s p three hybridized orbital in this particular fashion where you have one s p three hybridized orbital and another sp³ hybridized orbital for example of a carbon pointing in the same plane of the which is a plane of the black board for example the other hand the third s p three hybridized orbital is inside the plane of the black board the fourth sp³ hybridized orbital is in the projecting outside the plane of the black board forming a tetrahedral arrangement of

So if you want to draw this this is a carbon one of the orbital is like this the other orbital is again on the plane of the board only the third orbital is behind the plane of the board and the fourth orbital is projecting in front of the plane of the board which is drawn with a thick line like this

So this is a tetrahedral geometry is what we are referring to in other words if you want

to draw it in another fashion this is a hydrogen here hydrogen here hydrogen here the carbon is at the center of the tetrahedron regular tetrahedron

So the orbital will be essentially overlapping in this particular manner this will be going inside here and the fourth one will be projecting outside here let me draw it properly a tetrahedral carbon let me give a color coding

So that you understand the coding properly the blue one essentially goes inside the plane of the blackboard and the red one or the magenta one projecting outside the plane of the black board

So these two white orbitals are on the plane along with the carbon they are on the plane of the blackboard this goes behind the plane of the blackboard the blue one and the magenta one essentially projects in front of the plane of the black board one can also confine the tetrahedron inside a cube let me draw it over here you draw a cube in the cube the carbon is at the center of the cube and now you connect diagonally opposite corners of the cube that will be pointing at the positions let us say these two positions are connected to the carbon and these two positions are also connected to the carbon So this you can see here this will be projected this way this will be projected like this for example in this fashion only it will be projected as a tetrahedral carbon

So the tetrahedral lobes will be essentially pointing towards the there is another way of representing a tetrahedral carbon inside confined inside a cubical structure of this kind So it is important to understand the nature of the shape of the s p three hybridized carbon

So an s p three hybridized carbon essentially has four orbitals hybridized orbital in this particular fashion now how is methane formed once the s p three hybridized orbital is formed the 1s electron of hydrogen which is spherical in nature essentially overlaps with the sp³ hybridized orbital in other words this would be a carbon hydrogen bond for example this will be the one s orbital of the hydrogen and one of the s p three hybridized orbital of the carbon they overlap with respect to each other this again is a one s hydrogen orbital and the s p three hybridized orbital finally

So the tetrahedral arrangement is what is responsible the s p three hybridization is what is responsible for the tetrahedral shape of of a saturated carbon

So methane is formed like this how is ethane formed ethane is formed by overlap of one of the s p three hybridized carbon of the one carbon

So that will form a sigma bond sigma bonds are formed when orbitals overlap along the axis

So this is the carbon carbon sigma bond for example then you have c one s orbital hydrogen essentially forms the this will be essentially the structure of the ethene molecule the same structure can be written in this fashion indicating that one of the carbon hydrogen bond in this carbon and this carbon are projecting in front of the plane of the black board these two carbon hydrogen bonds are projecting inside the plane of the blackboard these two carbon hydrogen bonds are on the plane of the black board for example

So that will form two tetrahedral arrangement to be overlapping in this particular fashion

So this is one tetrahedron this is another tetrahedron they combine together form the carbon-carbon bond in a ethane molecule

So this is a simple way of explaining the shape of methane and the reason methane is tetrahedral is not a square planar molecule is because of the fact that the square planar molecule you have the bond angles closer which is 90 degree compared to a tetrahedral arrangement where you have the bond angle 109 degree 54 minutes or

So all the carbon hydrogen hydrogen bond angles are equal in a tetrahedral arrangement and the bond lengths are also equal its roughly 1.543 angstroms or

So 154 picometer is what the length of the carbon hydrogen bond in a molecule like ethane that we have sorry it is a carbon carbon bond of the s p three s p three carbon carbon bond is about one point five four three angstroms the carbon hydrogen bonds are about one point zero five or something angstroms for example the carbon hydrogen bonds are much shorter than the carbon carbon bonds in a methane kind of a molecule if the hybridization is carried out only with two of the p orbitals then you will have sp two hybridization in other words one s orbital and two p orbitals are hybridized together

So totally three orbitals are hybridized together with three electrons

So the three orbitals are oriented in this particular fashion in a triagonal fashion like this in other words it is the three orbitals are all in the plane of the black board only

it is a two dimensional structure one of the orbital is oriented along this direction the other orbital is oriented along this direction the third orbital is oriented along this direction for example

So each of the bond angle between the s p two hybridized orbitals will be hundred and twenty this is called trigonal geometry only three electrons are used up in the trigonal geometry in other words if you draw the trigonal geometry on a plane perpendicular to the plane of the blackboard it will be oriented in this particular manner the fourth orbital one of the p orbital with one electron will be perpendicular to that this will be dumbbell shaped this is the original p orbital p z orbital of ethylene sorry a p is an orbital of the carbon

So in a s p two hybridized orbital there are three orbitals pointing in a trigonal fashion like this in a triangular manner like this this is all in one plane which is on the plane of the black board if you just tilt it like this and look at it this is how it is going to look like with the fourth orbital which is the unhybridized p orbital which is going to be perpendicular to the plane of the paper that is shown here for example So if the hybridized molecular orbitals were to overlap with each other as in the case of ethylene they will overlap in this particular fashion this is along the axis of the hybridized orbital

So it is a sigma bond is going to be formed between two carbons and then you have a one s electron forming the c h bonds which are also sigma bonds for example remember we are now trying to describe the geometry of ethylene ethylene has this particular geometry where you have a trigonal hybridization here and a trigonal hybridization here for example this is one of the trigonal hybridized sp³ sp² system this is other trigonal hybridized sp² system for example in addition to that there is also a single p orbital which is in this particular oriented in this particular manner and the lateral overlap of this p orbital is what is going to give you the pi bond if one were to draw the orbital p orbital in this diagram let me use a different chalk here this would be the p orbital of the carbon this will be the other p orbital of the next carbon and the lateral overlap of the p orbital in this particular fashion gives a pi bond just to clarify at this point if you have a hybridized orbital which is overlapping in this particular fashion along the axis then it will form the sigma bond sigma bonds are always formed when the orbitals overlap along their axis on the other hand the atomic orbital namely the p orbital p is the orbital in this particular case this is the this would be the axis of the orbital they do not overlap along the axis instead they overlap sideways in this particular manner that will give you the pi bond

So it is important to understand the concept of formation of sigma bond and pi bond how they are formed in the organic molecule

So this diagram essentially explains the formation of ethylene by initially two s p two carbons overlapping with each other to form a carbon carbon bond and the remaining two s p two hybridized orbitals are overlapping with one s electron orbital of the hydrogen forming the carbon hydrogen carbon hydrogen bond here again carbon hydrogen and carbon hydrogen bond finally the fourth atomic orbital which is the p e z orbital which is perpendicular to the plane of the black board if this is ethylene is in this plane then this orbitals are projecting outside the plane of the black board or if you consider ethylene to be perpendicular to the plane then this will be on the plane of the black board in other words if you were to draw the structure of ethylene on a piece of paper which is this sheet here this is the orientation of the sp² hybridized orbital then perpendicular to that will be the orientation of the p orbital in this particular manner So this lateral overlap is what gives the pi bond of the ethylene in this particular case lastly now the angles are very clear this is 120 degrees this is 120 degrees

So sp³ hybridized orbital have 120 degrees and the carbon carbon bond for example has a length of about 1.45 or

So angstroms a carbon carbon double bond in this particular case finally you can take one s orbital and one p orbital combine them together to form only an sp hybridization

So you have sp hybridization that is being formed by combination of s orbital and only one p orbital the remaining p y and the p z orbitals are intact on the carbon such a hybridization is called s p hybridization since the two atomic orbitals combine to form the hybridized orbital you get two hybridized orbital in this particular the two hybridized orbitals are along the line

So this is linear geometry with a angle of 180 degree between the hybridized orbitals now if you have a carbon with an s p three sorry sp hybridized orbital another carbon with

another sp hybridized orbital like this they can combine together form the sigma bond this would be the overlap that forms a sigma bond

So this is a carbon carbon bond that is being formed then the other molecular other hybridized orbital combines with let us say for example one s electron of hydrogen So this would be hydrogen and this would be hydrogen

So you have basically explained the formation of the sigma bonds in acetylene this is a sigma this is sigma and this is also a sigma bond but then acetylene is an unsaturated compound it has pi bonds

So one of the pi bond is formed by the p z orbital overlapping with another p z orbital of the other carbon

So this lateral overlap essentially will give you the pi bond one of the pi bond then you have one more remember you have taken only one s and one p

So the remaining two p y and p sets are remaining in this one what we have drawn is the p z let us draw the p y in this particular fashion

So overlap between the lateral overlap between the p x sorry p y and p z orbitals essentially give lateral overlap of p y and p z atomic orbitals gives two pi bonds

So the pi bonds of acetylene are essentially formed by the overlap of the p y and the p z orbitals in a lateral fashion to give the particular geometry which is a linear geometry the carbon carbon bond length here is roughly one point two eight times trunks or

So its much shorter than the

So if you compare the structures of ethylene acetylene and ethane the geometry the bond length and the bond angles are easily explained on the basis of invoking the concept of hybridization this has 109 degree 54 minutes angle this is 120 and this is 180 this is a linear geometry this is a trigonal geometry and this is a tetrahedral geometry for example

So all the geometries of the organic molecules can be explained on the basis of invoking the hybridization namely sp hybridization sp² hybridization and sp³ hybridization however complex the molecule can be the concept of hybridization helps us to understand the kind of geometry and shape the organic molecules have in organic structures organic molecules can be classified and the classification is what i am going to discuss in the next few minutes organic compounds broadly they can be classified into open chain or cyclic these are called acyclic and these are called cyclic organic compounds the cyclic organic compounds you can have carbocyclic or homocyclic or you can have for example heterocyclic the open chain compound would be simply ethane the simplest example is ethane for example or butadiene is a open chain compound a cyclic compound will be cyclohexane or cyclohexene for example this is also a open join compound or if you want to go carbocyclic this would be hexane hexane and

So on heterocyclic compound you just need to have one heteroatom present in the system it could be oxygen it could be sulfur any one of the heteroatom can be present in the system

So these are examples of heterocyclic and homocyclic compound you can have aromatic or non aromatic compounds benzene would be a typical example of a aromatic compound hexadiene would be an example of a non-aromatic compound similarly you can have aromatic non-aromatic compounds non-aromatic compound would be pipyridine which is this particular structure the same thing if you want to make it aromatic you just put the pi bonds pyridine for example is an aromatic compound in the aromatic system you can have benzenoid aromatic non benzenoid aromatic compound aromatic compounds are benzene naphthalene anthracene all of them which have benzene rings fused together they are benzenoid compound on the other hand if you have a aromatic compound which is this is called azulene this is also an aromatic compound but it is not a benzenide aromatic compound you do not see benzene ring this is a seven membered ring this is a five membered ring fused together for example or you can have a seven membered ring like this which has a cationic structure here this is aromatic this is called the tropillium cation this is also aromatic in nature this would be a non benzenide compound

So in a broad manner the compounds can be classified into open chain compound or closed chain compound in the closed chain compound you can have carbocyclic or heterocyclic heterocyclic means it just has an atom other than carbon and hydrogen in the ring and the homocyclic compound can be aromatic or non-aromatic in nature examples are benzene and x or diene here again you can have aromatic or non-aromatic non-aromatic would be this one which has no pi bonds aromatic is the one which has pi bonds conjugated to each other the benzene the aromatic compound you can have benzenoid or non benzenide these are examples of benzenoid compounds these are examples of non benzenide compound

So in this lecture we took a short tour of the history of organic chemistry starting from berselius theory of vital force theory then moved on to our synthesis of urea then we moved on to the concept of hybridization to explain the shape and geometries of organic molecules finally classified the organic compounds in various category in this particular lecture thank you for your attention you

Prutor@IITK