so hello everybody i am professor j k ray of iit
kharagpur today i like to discuss with you some interesting topic that is organic
compounds containing nitrogen or you can call it in other way nitrogen containing organic
compounds now organic chemistry is a specialized science by definition it is the chemistry of
carbon compounds
so i should say carbon is a must carbon is a must in organic compounds one of my
favorite question to the first year students was can you name an organic compound having no
carbon in it you will be surprised to know some 30 to 40 percent students answer inorganic benzene borazine that sort of thing
but that is totally wrong because by definition the organic compounds should contain carbon
so as todays topic is nitrogen containing organic compounds
so carbon is a must i have shown
tetravalent carbon and i have attached it with a nitrogen atom and we know carbon is tetravalid
nitrogen is trivalent
so if you now satisfy the valencies with some substituents like hydrogen the simplest one the compound end up is methyl amine this is the simplest carbon nitrogen containing
compound methyl amine or methyl amine now what is the nature of this
compound i mean is it alkaline or basic is it acidic or neutral how one can tell because
we know a definition for acid base as per lewis is a lewis acid is electron pair acceptor
and a lewis base is electron pair donor as the nitrogen in this case is trivalent
having a non bonded electron pair
so this non bonded electron pair it can donate
so it is
basic in nature or let me write down it is a base and then question comes if i substitute some other
hydrogen atom with the methyl group then what will happen say keeping the two hydrogen intact
i put one methyl group instead of hydrogen and then the hydrogen atom over here
so this is some sort of molecular weight increase substitution
increase by which in some way the electron density of the nitrogen atom will also increase
so if i compare the basic character this will be more basic than the previous one
another way if i now substitute the hydrogen of attached to nitrogen atom by the methyl
group then what will be the structures if i write that thing that one of the hydrogen being replaced by a methyl group and the other one remaining intact then
what will be the nature of this compound answer is basic how much is it more than the
methylamine or less if we just analyze it little bit the way i have done for the previous example

that methyl group is an electron donating group because three hydrogen atom attached to carbon
will push electrons towards carbon as a result the methyl group will push the electron
to the nitrogen atom
so what will happen this nitrogen electron density will increase and
as per lewis acid-base theory the capability to donate electron will be more than the previous
one that means compared to methylamine n methyl amine will be more basic
and if i now increase one more methyl group into the system that means in
in dimethyl amine let me show the electron pair on the right hand side what
will be the nature of this compound obviously it will be the most basic of the
three or strongest among these three why the reason being two methyl group will increase
the electron density of the nitrogen atom
so the electron density will increase
so capability to
donate electrons also will increase
so it will be stronger base then question come very interesting
question that is it only the inductive effect which is playing is it some other effect which
is also helping in the increase of basicity answer is yes we can think about some other
interesting features what is that because as per bronsted and lauris concept of acid and base
and acid is a proton donor a base is a proton acceptor
so what will happen
if this base accepts the proton and then how the situation will take place
so let
us take this example versus the methyl substituted one what will see when this base picks up
a proton
so it will be now in h2 plus and next to that this carbon
having the hydrogen atom and also a methyl group what it will do it will increase the electron
density by inductive effect at the same time what it will do that with respect to this
nitrogen which is now positively charged there is a carbon that carbon having a
hydrogen atom directly attached to that we call this type of carbon is alpha carbon so
this hydrogen will be called the alpha hydrogen and if there be an alpha hydrogen
then this hydrogen could be shifted or the electron pair forming the carbon
hydrogen bond could be shifted to the carbon nitrogen system
so what we can write we can write
another interesting structure where this hydrogen is there and at the same time
the proton loss will take place
the there is no bond between carbon and hydrogen atom
so what
will happen this type of situation is very interesting when there is an alpha
hydrogen atom what is an alpha hydrogen atom with respect to a substitution
from which we are taking that thing there is a substituent next to that is the

alpha
carbon and any hydrogen being attached to that as the alpha substituent
so that can helps
in a phenomena called hyper conjugation
so hyper conjugation also help
to stabilize a species or an ion and this hyper conjugation is a very interesting
phenomena and that helps because we can write more no bonded resonating structure i have written
a term no bond the hydrogen is there h plus is being held over there but there is no bond
between carbon and hydrogen and and partially the bond has shifted and this type of thing
we should write with a double headed arrow that is symbolized for resonance or electron
delocalization
so electron delocalization is also called resonance and when one of this structure where we see no bond apparent bond is there then we call it as a no bonded resonance
and that also help to increase the basicity of the amines
so this is also a very interesting
phenomena which is found in carbon nitrogen compound with the substituents now let me
take a very simple thing
so we do understand that a simplest compound like methylamine
is a nitrogen containing organic compounds it has methyl group and an amine group if we
substitute the hydrogen atoms of the amine group by the methyl group the electron density
increases by hyper conjugation and also by inductive effect because electro negativity
difference is there between carbon and nitrogen so the bond being formed between nitrogen and carbon
will be shifted more towards the nitrogen atom and that when being relate to the next
atom that is called induction and that phenomena is called inductive effect and that is
highly specified for the electron donating group or electron withdrawing group we can easily
identify by analyzing each bond whether a group is electron donating or a group or atom is
electron withdrawing
so based on that we can write the structure and we can also calculate the electron density and see that whether a species can donate electron or can accept electron so
this electron donating phenomena when increases the basicity increases as simple as that now
i will write another very interesting field how to know or how to prepare this type of
compound very simple compound carbon nitrogen bond one simplest way to write that thing
is an arrow like this if somewhere we write an arrow like this this arrow is reserved for retro means reverse synthesis
so retrosynthesis means reverse synthesis i

say that if we know how to make a compound we should know how to break the compound so
now i will take it in the carbon nitrogen bond formation if i know how to make a carbon nitrogen
bond that is the thing i am going to talk about i should also know how to break that thing and
what are the starting materials will be needed to make this compound
so this type of arrow when
being written that means it is the retrosynthesis
so if i break this carbon nitrogen bond
i end up with two species one is a methyl another is nh2 but question is this
methyl and nh2 is the some concept this is not the actual species or this is not the
actual molecule
so what are the starting material to start with to prepare the compound like
methyl amine that means how carbon nitrogen bonds could be connected with the help of what
sort of static material what are the condition now this concept of breaking this
methylamine to methyl and amine is sometimes called these species are synthones
synthones are the concept not the actual molecule the why i am telling these synthones are
concept because this from these synthones by putting something we can get the synthetic
equivalent and those synthetic equivalents are the actual molecule or the starting material
and if we can combine those two starting materials and in under appropriate condition then
we will get back the target molecule so i should write methylamine in this case is
tm tm is the abbreviation of target molecule and these synthones are methyl and amine makes
because this methyl may be positively charged may be negatively charged maybe a radical
likewise nh2 also the nitrogen atom may be negatively charged may be positively charged
or it might be also a radical
so if i get a methyl radical and i mean radical these
are the concept these are the synthone if they recombine then you get the methylamine
likewise if i get methyl plus that is carbocation i mean minus they can combine plus and minus
easily
so you can get methylamine if we get methyl minus then i should have to get that amine plus
and then also it can combine to make methylamine and there are many other possibilities like
carbon not necessarily will have to be carbon ion carbocation or radical it might be carbene
carbene is a bivalent carbon that you know having a non bonded electron pair and this
non bonded electrons pair may be spin opposed or spin parallel
so this type of carbenes are

very interesting and sometimes this carbene when being reacted with electron rich nitrogen when the
electron density of that nitrogen is more we call it electron rich nitrogen then what will happen
they will form again the nitrogen carbon bond
so this nitrogen carbon bond formation
could be done in many ways carbocation nitrogen anion carbon ion nitrogen cation
or carbon radical nitrogen radical or taking carbine with electron rich nitrogen or vice
versa nitrine nitrogen is is also an elec very interesting reactive intermediate with
electron rich carbon that means all the possibilities are there but the most common or
both simplest procedure is by taking methyl plus why i am taking methyl plus this is the
concept i told you that this is the synthone
so what should be the synthetic equivalent
the synthetic equivalent will be putting the negative charge on or connecting it
with an electro negative element let us take a very good that is iodine as the electronegative
element
so it will be methyl iodide now it is a stable molecule i should
write this is the starting material one s m one s n stands for starting material
likewise i have to take the n h two minus because c s three plus should combine with
n h two minus two makes c h through n h two methylamine
so how to get n h two minus again
this is the synthone i should combine it with an electropositive element that element may be
sodium may be potassium maybe other metals
so as simple as sodomite when treated with methyl iodide
in nh2 with methyl iodide
so what will happen the methyl iodide will react with n h two minus
the counter ion is in a plus
so this will attack to this carbon and the carbon
iodine bond will break
so we will get some sort of transition state remember i use a term
transition state where iodine is leaving and nh2 is entering the system
so this type
of transition state and not intermediate t s stands for transition state
will give a product where nh2 is entering from one side and iodine is leaving from the other side
so this is called and substitution nucleophilic
bimolecular or sn2 type reaction
so what is sn2 a stands for substitution n
should be subscript but in capital and two should be of the same size as s not s n square
some people say like s n square no it is s n two the full form is substitution nucleophilic bi
molecular because in this case the two molecules are sodomide and methyl iodide and this is a

substitution reaction iodine is going out iodide and nh2 is entering
so it is i write substituted
by nh2 and through a transition state and no intermediate
so it is a bimolecular reaction
so substitution nucleophilic bi-molecular
so in this way we are able to make the carbon
nitrogen very simple compound and taking other substituents we can make ethyl
in propyl isopropyl
t butyl n butyl isobutyl all these type of amine compounds
so i can write a geneal formula that
r n h two is the general formula of the alkyl amine now this alkyl amines are
very interesting
features because it contains carbon nitrogen bond and this with this carbon
there may be
several substitutions or there may be unsubstituted very simple
compound like methyl amine
so to prepare this compound is very easy very
simple chemistry even methanol and ammonia could also produce but basic
concept is a simple
substitution nucleophilic reaction i told you that it is not restricted to
only this type of
reaction there are several other possibilities it may be ch3 minus reacting
with n plus but
this is the one of the simplest way to make the alkyl amine now i am just
doing one more thing
over here i am substituting one of the hydrogen of this alkyl amine with a
carboxylic acid
group with a carboxylic acid group c o o h rest of the thing remaining intact
so r c h n h that means this was there one of the
hydrogen being replaced by c o o h we know c o o h is the abbreviation of a
carboxylic
group carboxyl that is carbonyl is co hydroxyl is o h together it is carboxyl
now this type of compound why did i write starting from carbon nitrogen just
one substitution of the hydrogen by a carboxylic acid group because you know
this type of compounds are present in many biologically active compound one of
the simplest
compound is amino acid what is the amino acid amine group is present and it is
also an
acidic group is also present
so amino acids is a very simple compound where the nh2 and
coh group both are present in the molecule
so this is also very interesting class of
carbon nitrogen organic compound or i can say the nitrogen containing organic
compounds are very
important in everyday life one of this example is amino acids what i have
written because this is
the normal trick when the carboxylic acid group is a functional group being
present next carbon
is called alpha next to next carbon beta next to next gamma in that way we can
go up to omega
so based on that the amino group is substituted whether in the alpha position
beta position gamma
position or delta position we call that thing as alpha amino acid beta amino
acid gamma amino

acid delta amino acid like omega amino acid
so these amino acids are very important class of
compound and this will be called alpha amino acid and looking at this
structure you can
easily guess that this compound is nothing but a simply substituted if i put
r is h then this compound is ch2 nh2 cooh and you know this compound is nothing
but acetic
acids one hydrogen being replaced by an nh2 group and this is called the alpha
amino acidic acid
or trivial name is glycine glycine is a very important amino acid likewise the
higher
substituted or beta substituted amino acid gamma substituted amino acid could
also be
obtained and those are the building block of another biologically important
compound that is
proteins and peptides and peptides again being linked to polypeptides that is
polymeric things of the peptide
so in that way one class of compounds
biologically active compounds peptides two polypeptides all those things are
coming and
the review or the umbrella of carbon nitrogen compounds that is nitrogen
containing organic compounds now if i write down some of the interesting
features
of this compound like if i take say carbon nitrogen i told you at the beginning
that carbon
nitrogen bond is a must and in this case another functionality is being fixed
that is coh and
remaining thing let us put in this case is hydrogen and of course i have to
satisfy the
valency of nitrogen
so it is ch2 nh2 this is coh alpha amino carboxylic acid
so i
have rewritten the glycine structure you look at this nature of this
compound you have a nitrogen atom whose valency being satisfied as two
plus two four with the two hydrogen six but this it has a non bonded electron
pair
so what this amine can do it can donate electron that we have seen
so it is
a base at the same time the same molecule in the other portion we having a
carboxylic acid
group co h we know acetic acid is acidic in nature carboxylic acids are acidic
in nature why because
if it loses proton the remaining part that is co minus that is conjugate base
gets stabilized by
resonance and one of the interesting feature of that resonance is we get a
symmetrical resonating
structure this is the carboxylate ion which can resonate and can give the
resulting structure like
this
so the resonance hybrid should be written in a way that the negative charge
is getting
delocalized over the whole region we cannot identify which oxygen is keeping
the negative
charge for how many time it is getting delocalized

so more the identical structure that is
very important term identical structure more the stability we know calculate structures
contributions towards resonance hybrid is maximum
so that sort of phenomena is taking place
over here also the carboxylate ion is getting stabilized by symmetrical resonating
structures because of that carboxylate ion will be more stable
so the conjugate base is
getting more stable
so loss of proton will be easier
so anything any species which can
donate proton easily will be called an acid
so carboxylic acids are stronger acid compared
to say phenol or other substituted compound
so that is the reason
so you have an acidic
group you have a basic group in this molecule
so what will happen in the same molecule
one basic group is there another acidic group is there we know a very general rule
acid plus base gave rise to salt and water in organic chemistry we write it in this way
a very simple compound r c h two o h that is a primary alcohol being treated with r prime just
to make it different i have written this structure and if we treat with a carboxylic acid with a
different type of alkyl group methyl ethyl etc in presence of acid mostly which not only
is a good acid but also a dehydrating agent that means it takes off water i am giving you
very simple example little bit of concentrated sulphuric acid is good enough we end
up with a compound that is r one c o o c two r what is this now this compound is
nothing but a carbonyl group is there and och2r is also there
so this type of compound is
called an ester ester having sweet smelling mostly
so this ester functionality is a very important
feature for an alcohol and a carboxylic acid
so alcohol and carboxylic acid when getting mixed
together in presence of sulphuric acid little bit which acts as a not only acidic reagent but
also a dehydrating reagent
so that helps in the production of an ester together with some
water will be formed and that water will be taken care of by the sulphuric acid
so this
reaction will be called esterification reaction
so we understand that when
an acid group is present and a basic group or neutral group is
present they can form an ester like this but in this case the point what we have taken
that amine and carboxylic acid group what they can do because one basic group

and another
acidic group one interesting feature of this is acid is a proton donor base is a proton
acceptor
so what it will form it will form a species like this what i have written i have written that c h two c o o minus and with the c h two the substituent is nh3 plus
what is this how this is coming from the simple compound that is glycine answer is as the
nh2 group and coh group are in close proximity one is then basic proton donor another is an
proton acceptor
so what happens in this case the base picks up the proton from the carboxylic acid
group making it a carboxylate and as as i told you that carboxylate gets resonance stabilized in this
way and nh3 plus is also in that way is quite good
so this type of features is called joitar ion
or double ion one positive another negative in the same molecule
so one of the interesting
features of this amino acids mainly glycine and other derivatives are the joiter ion formation
geotaron means two types of ions being formed in the same molecule where the proton transfer
is taking place from the carboxylic acid group to the amine amine is accepting it and carboxylic
acid is donating it because by definition bronsted and lowry that a carboxylic acid group is a proton
donor and a basic group is a proton acceptor
so this sort of phenomena is very much present in
amino acids i am not going into details of other amino acid because those are the building blocks
of life in one sense the proteins amino acids and peptides and polymerization of that
give polypeptides all these are very much in the domain of carbon nitrogen containing
compounds or i should say nitrogen containing organic compounds
so this is one class
of compound but it is not only that now if i write going back to the amine thing that i have a carboxylic acid group and also i have an amine group and if i
do a similar sort of reaction let us take by heating that and with the help of some
dehydrating agent the water being taken out from that the difference of these and the previous
one is that this wa in ester formation we had an alcohol and a carboxylic acid in this case we
have a carboxylic acid group and the amine group in the close proximity and being heated
that means water being eliminated
so what will happen this might happen a very interesting
phenomena and can produce a compound like this where you get a three member carbon nitrogen and
the third one is the carbonyl group compounds like this and these class of

compounds are
very very important because i should say this type of compounds ah can you name this type of
compounds answer is yeah it is a cyclic compound having nitrogen atom in it and also there have to be carbon in the compound
so carbon nitrogen
containing three membered ring this is the simplest way to describe this but this is
not the only thing by which we are making the carboxylic acid and amine to combine to make
a compound like this there are many other ways but right now our attention is focused on the
amine and carboxylic acid intramolecular reaction i should say in this way just to simplify this
fat that which and one of the hydrogen of the nh2 is leaving as water and the remaining thing is
getting cyclized to make a heterocyclic compound what did i say this is the heterocyclic compound
why heterocyclic compound because this is the cyclic compound node out to make a ring
you need at least three atoms here carbon is one another carbonyl is second and nitrogen
is third
so three atoms are there
so it is a three member cyclic compound and one heteroatom
is there in the ring
so it is the heterocyclic compound
so definition of heterocyclic compound
is now the heteroatom containing cyclic compound earlier definition was it will have to be aromatic
now it is called the aromatic heterocyclic compounds which are heteroatom containing cyclic
compounds but they are aromatic in nature also so any heteroatom containing cyclic compounds should
be called as heterocyclic compound
so from simple carbon nitrogen compound or amino acid we are able
to get a three member heteroatom containing cyclic compound and this type of compounds having
another trivial name that is called lactum ester is one type thing and it is a cyclic ester
let me put a simple example c h two o h c o o h that is alpha hydroxy carboxylic acid if i take
alpha hydroxy carboxylic acid instead of taking alpha amino carboxylic acid and
do the similar thing instead of taking the amino group i have taken the o h group that is the difference c h two h c o h and earlier one was an example of c h two n h
two c o h this is the difference what will happen it can also form a similar sort of compound like this but this is the difference here is in the three member ring the oxygen is there as one member in this case in the three member ring not oxygen
but nitrogen is there
so this type of compounds are called lactam and oxygen containing
compounds will be called lactone l c t o n e what type of lacto the carboxylic

acid
connected to the alpha carbon which is having the hydroxyl group
so this type
of linkage will be called alpha lactone ok
so three member oxygen containing heterocyclic
compound having one next member is a carbonyl group is called the alpha
lactone and three member
nitrogen containing heterocyclic compound next to nitrogen there is a carbonyl
group and other
carbon may be substituted or unsubstituted will be called alpha lactam
so this is the very
interesting cyclic compound being obtained from the amino acid if i take a
step forward and
write down another thing like ch2 ch2 nh2 and i put a carboxylic acid to the
beta carbon amine from the amino
functionality this is the first carbon is alpha second one is beta
so this compound
will be called beta amino carboxylic acid
so if i take a beta amino carboxylic
acid and do a similar sort of thing what will be the product the
product will be c h two c h two n c o by the loss of water and there should be
one
more substituent and this class of compound is very very interesting this is
called beta lactam
why beta lactam because beta amino carboxylic acids internal salt is beta
lactam this is a four
membered nitrogen containing heterocyclic compound and why did i write this
thing the answer is very
simple this type of structure or structural moiety is present in many
interesting compound one
of them is penicillin and you know penicillin is an antibiotic
so antibiotic activity is because of the opening up of the
lactam ring where the enzyme comes and open up the carbon nitrogen bond and
then this beta lactamase is the enzyme which helps
so starting from simple carbon
nitrogen compound we are going to the antibiotics that means i should say the
beta lactamase
monobac bacterm all these interesting features are coming from simple carbon
nitrogen
compound and one of the important field of carbon nitrogen compounds or
importance of
carbon nitrogen compound is in the antibiotic you can name many compounds as
antibiotics like
penicillin everybody knows cephalosporin those are nothing but beta lactam
containing
there are some other structural features but beta lactam is very unique moiety
and
which must be present in those type of antibiotics because it kill the
bacteria by
certain mechanism
so three member four member nitrogen containing heterocyclic compounds could
be prepared very simple way and they are used in everyday life is tremendous
not only amino
acid peptide protein but also the antibiotics and ah if i take the amine group

being
attached to the aliphatic carbon i end up with this series of compound if i take
the same amine group and attach it to the benzene ring that is also very
interesting feature say a benzene ring having an amine group i did not say anything
about the carbon nitrogen bond being attached where the carbon is an s p two hybridized and part
of an aromatic system and looking at this you can easily write down that this type of amine we know
this is nothing but aniline aniline is simple c6h5 in h2 and this compound interesting feature is it
is aromatic in nature that is it has a delocalized binge ending we can write it in better way not only showing the localized bond but putting it
a delocalized fashion like this and these two are the calculate
structure that is structure number one and structure number two and we know the
contribution of the resulting structure towards resonance hybrid is very important feature
if i calculate let us take this is carbon number one this is two this is three this is four this
is 5 this is 6 same thing i am writing over here and if i calculate the bond order bond order is being calculated by simple
technique that what is the nature of bond between one and two let us take one and two bond
order i want to calculate in structure number one one and two is a double bond and double
bond is taken as two in structure number two one two bond is single bond and single bond
is taken as one
so if i add them together it comes three and divide by the
number of resonating structure that means how many resonating structure we are able to write one and two because this is the delocalized form this is not the calculate
structure this is overall theme being written
so this type of resonating structure and their
contribution to the resonance hybrid is an important feature not only to know the nature
of the compound but also to find the bond order which helps us to do many things i will explain
that
so when the added sum that is 3 and how many resonating structures are there that is two
so divide the sum by the number of resonating structure that is
three by two that is the rule
so it comes one point five
so what is the general bond order of a
benzene ring where there is no substitution answer is one point five how because take any position
not only one two two you can go calculate for two three three four four five five six or six one
you will find alternate double and single bonds
so in a particular bond like as i have shown for
one two for double bond it is two for single bond it is one add them sum is

three divide by the
total number of resonating structure in this case two it is one point five
so bond order is one
point five
so one important feature in benzene is all the bonds are equivalent not one
larger
another smaller this is in that way uniform or equivalent
so 1.
5 is the bond order but if we
look more precisely the what is the nature of this this the localized
structure will find there
are each carbon atom having the pj orbital because all these are sp2
hybridized
carbon and this pga orbitals gets with the help of the electron delocalized
not
only in the top but also in the bottom but just to clarify the thing i can say
that you get a
hexagonal thing and top of that or in the bottom of that and electron clouds
are there
so this
is overall picture of the binjin zing why did i write that thing because if
you break the
aniline molecule the way i did for alkyl amine you will end up with very
difficult problem
what is that benzene ring as the plus nh two as the minus that is very very
difficult
why because benzene ring having the electron cloud on top and bottom which are
negatively charged
so when you bring an n h to minus to these what will happen they will repel
so there will
be no carbon nitrogen bond formation possible
so in that way what is happening we will
have to look for some other fenna phenomena that means carbon nitrogen bond
formation
by taking benzene ring as the plus moity or electron deficient one and taking
the amine as the
electron rich will not do in other way i can say the nucleophilic substitution
or the attack by the
nucleophile to the simple benzene ring does not happen why because electron
same electrical
charge repel each other
so electron cloud are negatively charged and when you are bringing
a nucleophile that is also negatively charged they will repel
so what is the solution to that
solution is very simple that if we take instead of n h to minus n h to plus
then the problem will
be solved that means a positively charged things could make very easily
attracted to the negatively
charged species and i will write how this thing happens but question come nh
to minus to nh to
plus that is reversal of polarity will be very very difficult i will come to
that but if i write
a binging ring in this way it did delocalized system and i bring an electrophile
not

nh to minus but no2 plus then there will be very interesting feature
so these are the substrates benzene ring delocalized n o two plus that is the electrophile not nucleophile
so this electrophile will come very close vicinity of the benzene ring and they will form a charge transfer complex type thing i can write this thing in this way there is no full bond being formed but the electrophile is taking the electron pair which is a delocalized form from the benzene ring to form a complex rather to call it complex and this type of complex is called a pi complex
so a pi complex is being formed by the benzene ring as a donor and nitro group as the acceptor or n o two plus as the electrophile and benzene thing as the nucleophile because it is electron rich species ultimately what will happen it will form a direct bond with the nitro group and there will be one of the benzene ring has shifted over there and there will be a positive charge on the other end there is a hydrogen over here there is another hydrogen in this side
so there will be a direct no2 with the benzene ring being connected
so we have got some species where the aromaticity of the benzene ring is temporarily lost at the same time a new sigma bond is being formed between the carbon and the inode group or carbon and the nitrogen and this type of again it is a complex it is not the stable in that way it is not a neutral molecule
so this type of complex is called sigma complex because the sigma bond is being formed then what happens the hydrogen atom is being donated to make the aromaticity regain so benzene ring is now gaining its aromaticity and the nitro group is being directly attached
so what we see over here from this figure that if i treat benzene with no2 plus i will get a pi complex where benzene ring is the doughnut n o two plus is the acceptor then i will get a sigma complex where the direct carbon nitrogen bond is being formed there is a carbocation in the next carbon and then by the loss of the proton the aromaticity is regained and the substrate is being converted to the product product is the nitro benzene
so this type of reaction is called electrophilic substitution reaction so electrophilic substitution reaction is very common in aromatic system
so i started with aliphatic systems substitution reaction that was nucleophilic substitution reaction they are directly we went from a benzene i mean the alkyl amine preparation and in this case we are going from a benzene to the amine by step wise process

why because
amine as such introduction is very difficult
so what we are doing we are putting a nitro
group and then after this nitro group is introduced then we can see that the substitution
reaction has taken place and if i ask you how can you convert this nitrobenzene to
aniline look at this very simple answer is by reduction by reduction means by taking
hydrogen especially nascent hydrogen is very good by tin or zinc and hydrochloric acid will be
good enough to liberate nascent hydrogen which will convert nitro to the amino group
so to sum
up the things what i have discussed now that nitrogen containing organic compounds are
important in everyday life starting from simple amine basic compound to amino acids building block
of proteins peptides polypeptides to another class of very interesting compound that is amino
acids derived things like lactose alpha lactam beta lactam i did not go to the gamma lactam or
delta lactam also will explain this thing later and beta lactam is the structural features
present in penicillin cephalosporin and many other antibiotics
so these are the very
important features of the nitrogen containing carbon compounds or organic compounds
better to call carbogenic nitrogen compounds and second thing is aliphatic
amines could be prepared very easily from nucleophilic substitution reaction but at the
same time aromatic amines to prepare you will have to go step wise that means put some group which
could be converted to the amine very easily one simple example i gave you is the amine group or
nh2 group and that could be done from nitro by simple reduction zinc cortine and hydrochloric
acid
so i will continue with some other features of the aromatic nitro compounds and aromatic amino
compounds
so that carbon nitrogen bond will be very interesting to get some more interesting molecule thank you you