hello everyone i welcome you all in series
of the lectures in biomolecules and today is our ninth lecture before going to the details
of the lecture ah i will like to give a recap of my last lecture in the last class i was
talking about the structure of proteins and there we discussed about the you know all
ah kind of structures ah which has been divided particularly in four categories
ah primary structures where we focus on number of amino acid and the disulfide bands
ah particular number and type of amino acids ah in the secondary structure ah we ah look over
ah the segment the repetitive segment that how they have arranged in the you know protein ah
and how how are they you know ah ah kind of ah having ah structure what kind of structure they
are having and ah when we looked in the details there we found that ah two types of ah structures
are there alpha helix and beta plated sheet in the alpha helix we saw that you know coil kind
of structure is there ah and in the beta plated seeds we saw that you know how by hydrogen bonding
you know two ah chains are you know ah kind of ah arranged one way of the other ah it can be
parallel it can be anti parallel ah then we talked about you know tertiary structure
so inter
series structure we we were talking about ah that
so tacit structure basically it is a three dimensional arrangement of
all atoms in the protein it is a three dimensional arrangement of all atoms in the protein protein folds is spontaneously in the
solution to maximize their stability spontaneously in the solution to maximize their stability how how will it protein force is spontaneously
in the solution basically what happens that when it folds it starts you know having ah binding
hydrogen bonding ah in between the different segment of the protein and ah because of that
hydrogen bonding its a its it gets stable and its a energy gets minimizes
so as long as its a keep
on reducing its energy and we know that you know it is a natures la that every entity in the nature
wants to be in the minimum energy state and thats what happening by by ah binding it releases energy
and that leads to the stabilization of the protein
so ah it in the solution it tries to fold
so that
by folding it will have different kind of binding ah in different segment of the protein and that
leads to the maximum stabilization ok every time there is stability stabilizing interaction that between atoms that releases free energy
so every time there there is a stability
stabilizing interaction between atoms that releases free energy ok and the more free energy

is released the more stable the protein is
so i if you are having kind of linear structure
consider this is linear structure and if it gets folded it it it pro this folding is providing you
know maximum possibility of burning in the same you know basically peptide chain and
that is how it it it gets stabilized
so what kind of these stabilizing energy
interactions are i told that you know every time there is stabilizing interaction between
atoms that releases free energy and because of the release of this free energy it
gets stabilized what are the kinds of these interaction
so stabilizing
interaction let us talk about the stabilizing interactions establishing interaction in
protein include disulfide bonds
so consider if the protein is having two s h group it can you know lead by folding
and the two s s group can get converted to the disulfide
bonds it can get get converted
so this one this possibility can happen ok this
is disulfide bond second second is hydrogen bonds first i am giving this general example that you
know how this stabilizing interaction helps this ah you know protein to ah be stable ah and you
know ah that that leads to the tertiary structure ah now ah after this i will again give one
individual example and with that i will explain it
so hydrogen bonds
so as i mentioned that you
know um basic as well as acidic part in the same peptide chain can lead to the you know
hydrogen bonding basically if you have carbonyl group as we have seen and carbonyl
oxygen and nh of the amide bond of the two different amide groups can
lead to the hydrogen bonding
so that possibility also exist then
third is electrostatic inter attractions electro is static attractions
electrostatic attraction and fourth is hydrophobic interaction hydrophobic interactions all right
so these are
the stabilizing interaction between the peptide groups basically can ah lead to the
you know tertiary structure now ah before going to the you know ah quaternary structure i will
again ah like to you know categorically explain that you know how primary structure secondary
structure and tertiary structure gets arranged
so what happens in the as i
mentioned in the tertiary structure tertiary structure gives a specific overall
shape to the protein tertiary structure structure gives a specific overall shape to the protein what does it mean as i mentioned that you know

alpha helix the coiled structure where we saw that you know two repetitive units can come you
know ah particularly ah two ah um you know ah amino acid which are having four ah residue
gap that can get involved in hydrogen bonding ok ah the another is ah you know beta pleated seed
in the beta plated seed again you know carbonyl of one peptide group and nh of another peptide
group can involve in hydrogen bonding
so that is the another and it it can be parallel
or anti parallel two types are possible
so tertiary structure gives a specific
overall shape to the protein and it involves it involves interaction and class links cross links between different
part of the peptide chain between different part of the peptide chain different part of the peptide chain i have
already mentioned that it can be stabilized by again i am reporting repeating as i mentioned that you know there are stabilizing interaction
again i am repeating just to put emphasis on ah those interactions so
it it can be stabilized by hydrophobic hydrophobic interactions hydrophobic and hydrophilic interaction hydrophobic and hydrophilic philic interactions hydrophobic and hydrophilic
so what is hydrophobic interaction hydrophobic interaction means like you know
alkyl group are there
so alkyl group if if they basically interact
so these interactions
our aerial group are there
so their interactions are called hydrophobic interactions whereas hydrophilic interaction what is hydrophilic interaction hydrophilic interaction
is basically if there is possibility hydrogen bond formation
so if
substituent is considered c h two o h and if you have in the you know vicinity if
you have water molecule
so with that it can give the you know hydrophilic interaction so
it has either water molecule or alcohol so this interaction is called hydrophilic this is
also you know stabilizing interaction ok then second is salt breezes salt breezes formation
is also stabilizing interaction salt salt bridges
so what is salt bushes salt
bridges basically if you have carboxylate group in peptide chain
so carboxylate
group will have negative charge and in the same peptide chain if the amino group is
in the ammonium firm basically
so that will be positively charged
so um to make
it more clear i am putting here negative and here positive now these two carboxylate is negatively charged and ammonium is positively charged it will have interaction
ionic interaction among themselves

so salt bridges then the other ah salt bridges basically it
becomes like you know charged interaction then third one is hydrogen bonds
hydrogen bonds hydrogen bonds that i have already
mentioned that hydrogen bonds are possible
so carbonyl and if the hydrogen is available with
the alcoholic substituents are amidic substituents any possibility will help
so this alcohol one i
should and then again for the amidic interaction
so this is another higher and the final one i i mentioned that you know
disulphide bridges that disulfide reduces bridges you know this is another ah
stabilizing interaction
so ah now i am
assuming that you know i have ah completed that you know in the tertiary
structure what kind of
you know stabilizing interactions are possible ah we started with the
hydrophobic and hydrophilic
interaction then we move to ah you know ah salt bridges salt bridges are
possible if we have in
the polypeptide chain if we have carboxylate group and the ammonium group
so there that interaction
is possible then we came to the hydrogen bond ah in hydrogen bond also you
know we saw that
you know it can interact with the alcoholic r amidic nh ah are you know i can
say
that amine nh are l you know ah and ah now finally i mention about ah ah
disulfide
this formation
so these are the you know um basically ah stabilizing interaction ah to
compile
all together you know i will like to make a structure where these all
interactions
whatever i have mentioned about the tertiary structure ah i will
like to incorporate
so let me draw this structure please see this drawing
carefully and that that will help you in ah
so here i am making the you know helical
structure to basically repeat the the kind of what to say we are having a alpha
helix ah as i mentioned in the tertiary structure and then i talked about the
beta
pleated seat over here
so this will again weta pleated sheet and you know in
the segments and then again i am making here you know helix and that that will
you
know give you
so to make it better i will just into just in the tape form i am making
this picture
so that it will get more clearer and
so this is the you know helix part and
this is you know i am denoting here ah this is here beta plated um seed part
actually
so this is a beta pleated seed part again
and this is rest of the i am just making this yeah
so now now i completed this you know its a
big polypeptide chain

so now now i will you know make all the structure
so ah let me first show you basically ah you know salt bridges the
salt bridges to represent salt bridges i am putting you know ammonium as well
as
you know um the ester part
so ah
so that
so so this is the salt bridges and then i
will hydrogen bonding to represent hydrogen bonding in the different segment
i
will put here ch2 oh and another ch2 os group
so this is another hydrogen bond
so let me write here this is salt bridge this is salt bridge and this is
hydrogen bond just i am making more my drawing bit more clear so
you should not have difficulty in understanding ok hydrogen bond now i will put
the beta plated
seed if you consider the two you know ah parallel chains are there and there
this hydrogen bonding
is taking place i will note it with the you know this hydrogen bonding
so this is beta pleated seed beta pleated sheet ok ah this
also has hydrogen bonds
so hydrogen bonds again here now i will
talk about the disulphide bridges
so disulfide bridges as i mentioned
that if thiall groups are there and that will lead to the disulfide bonds
disulfide bonds that is also stabilizing
interaction now hydrophobic interaction let me mention some hydrophobic
interaction for hydrophobic interaction i am putting here benzyl group binding
group and the another benzyl
group consider from the amino acid
so this interaction and and basically you can
have here even c h three also
so these interaction these interaction
so c h three ch3 group
so this is
called hydrophobic interaction hydrophobic interaction hydrophobic interaction
hydrophobic interaction and this is
you can see that i told you this one this one these all are like you know
tertiary structure this is alpha helix alpha helix ok and in alpha helix
also we have hydrophilic interaction
so hydro to demonstrate hydrophilic
interaction i will make here as i mentioned that ohs will interact
so consider
it has phenolic oih and the other one is having c h two o h
so this interaction
is hydrophilic interaction
so hydrophilic interaction hydrophilic
interaction ah basically to water because they are having o h
group
so and another rig i i will ah show here ah you know salt bridges
again
so this carboxylate and here you are having ah you know regular amide group
that can also have this you know hydrogen bonding
so i hope i here i have tried to i

have tried to demonstrate all kind of stabilizing interaction through this big you
know polypeptide chain and there i have you know mentioned all ah all ah stabilizing interactions
so now now ah i will like to ah exemplify basically ah if you take an example of you
know ah global proteins globular protein are spherical in shape and ah to exemplify it i
will take the myoglobin my what is the role of myogrobin basically myoglobin transport oxygen
into the muscles basically oxygen to muscles and where because of that we get energy and ah
the example of this was the global protein and example of fibrous protein ah long fiber like
you know shapes is alpha carotene ah which make up makes of ah you know hair skin and
nail nail you know basically ah and feathers contain beta creatine
so let me write down so
that you should not forget
so globular protein globular protein exemplified by the myoglobin myoglobin basically carry carry out synthesis
transport and metabolism in the cells these carry out globo protein carry out synthesis transport and metabolism metabolism in the cells and myoglobin basically transports oxygen to the muscles basically fibrous
protein now lets example of fibrous proteins fiber proteins consist of consist of long fiber like shapes fiber like shapes fiber like shapes and
for example easy alpha creatines which make makes up hair wool skin and nails
so fibrous protein consists of long
fiber like shape consists of long fiber like shapes and to exemplified
alpha cretins alpha creatines make up hair wool skin and nails ok
feather contain beta creatine feathers contain beta-keratin beta key ratings with large amount
of beta plated situated structure as you can see that structure of feather with large amount of beta plated system structure ct structure beta platinum ok let me make some you know drawing
so that you can understand well let
me draw the you know ah basically alpha creatine structure here i am making representation for alpha keratin basically to just just i am
trying to depict alpha helix structure you can see that you know
coiled structure is there
so this one can give you feeling that you
know how this coiled structures are
so alf this is the alpha creatine this alpha helix basically ok now ah i will move to quaternary
structure basically i will move to you know quaternary structure
what is quaternary structure
so this much about the tertiary structure now
let us talk about the quaternary structure quaternary structure in quaternary structure
some protein have some proteins have more than one polypeptide chain now in the quaternary
structure a protein you know the individual chains are called subunits and how how are
they arranged in respect to each other

so in the quaternary structure basically it
has more than one polypeptide chain and these polypeptide chains are how arranged with respect
to each other
so that is important basically
so so some proteins have more than one polypeptide more than one polypeptide chain and the individual chains are called subunit are called subunits a protein with a single
subunit is called a monomer with a single sub unit is called a monomer a monomer one with two sub unit dimer one with two sub units called dimer and
similarly if three sub unit three subunits trimer four subunit four subunits called tetramer
so as i mentioned
that in quaternary structure ah some proteins have more than one polypeptide chain and the individual ah polypeptide
chains are called basically subunits and basically in quaternary structure we look after
that how these ah you know polypeptide chains more than one polypeptide chains are arranged
in respect to each other
so for example if a protein is having tetrameric you know
tetramer basically four units
so how how are they arranged to to make it more clear i
will make the structure over here
so one monomer another one and as it is tetramer
so i will draw all the four
so these are the you know particularly
the sub units can be same are different here here i have made like you know two
same two sames and ah to exemplify it you know i will give example of here
ah hemoglobin hemoglobin is a tetramer for quaternary structure
hemoglobin i am exemplifying and it is a tetramer hemoglobin is a tetramer tetramer
so here it has basically alpha chain again alpha chain and here beta chain beta chain
so the quaternary structure of a protein describes
the way subunits are arranged with respect to each other a quaternary structure of a protein
describes the way different force of units are arranged with each other here you can see that
you know in quaternary structure ah basically ah we look after that you know how different
polypeptides chains are arranged with respect to each other and ah these peptide chains are
you know called basically subunits are ah you know if it it has one subunit then it is called
monomer if it has two subunit then it is called dimer if it has three subunit then it is called timer and if it has four then tetramer ah hemoglobin is
a good example of quaternary structure where four subunits are arranged in a specific
way ah in the protein two alpha as well as two beta ah chains ah as you can see
through this example its a tetramer ah

so basically the sub units of protein are
held together by same kind of the subunits of a protein are held together by the
by the same kinds of interaction that hold the individual protein chains that
hold the in the visual protein chains in a particular
three dimensional conformation three dimensional conformation what are those as
we discussed about the
tertiary structure they are namely hydrophobic hydrophobic interaction hydrogen
bonding hydrogen bonding and electrostatic attraction and electro static
interactions basically
electrostatic attractions
so ah now i have completed you know all the four
structures primary secondary ah tertiary and quaternary structures and ah i
hope ah i am able
to convince you that you know how these structures ah ah are ah you know ah
gets stabilized in the
primary structure basically we ah learn about the ah number and type of amino
acid and the
disulfide bridges in the secondary structure we look over that you know what
are the repetitive
segments and how are they arranged and there we talk about the alpha helix and
beta plated seed in
the ah basically in the tertiary structure ah you know um all other kind of
you know ah stabilizing
interactions ah you know ah play a role ah and in the quaternary structures ah
we look after
you know basically how ah in you know ah if the proteins are having more than
one polypeptide
chain more than one subunits then how these ah subunits are arranged ah in
respect to each other
ah that forms the ah you know quaternary structure and there we ah that one
will be exemplified
by the hemoglobin in the case of hemoglobin which is a tetramer ah it has two
alpha as well
as two ah beta units and how are they arranged ah
so to summarize all these you know i will make
another schematic presentation
so let us let me first draw the primary structure and then primary
structure lead to the secondary structure so basically in the primary
structure i am
making the you know um polypeptide chain
so this is ah it if it is nh and then again i am making the bond over here and
then this carbonyl band then again
so this is the peptide chain
i am ah you know drying here now this this represents ah basically primary
structure this is primary structure what the peptide changes
so type of amino acids and number
of amino acids
so this is primary structure primary now this primary structure
so this primary structure in peptide
chain you know can get folded and that will make the you
know ah helixes are you can say
so this is forms the secondary structure now here
you know peptide chains are like you know kind of folded and this leads to the
secondary secondary structure and then then it then this secondary structure can

again you know get stabilized by different kind of band and that will give you tertiary structure
so here i am i am presenting the this is tertiary structure tertiary structure this is tertiary
structure and in basically in this tertiary structure we have you know these secondary structure folded basically you can see here you know this is in this structure
so this this
is the series structure and finally quaternary structure
so in quaternary
structure as i mentioned that you know how the different sub units are arranged with respect to each other
so this becomes the you know quaternary structure quaternation this is overall schematic presentation for structures foreign structures this is schematic presentation for structures
so ah again i will like to ah
summarize ah whatever i have discussed today we discussed about the primary structure
we discussed about the secondary structure there we talked about you know how ah the
repetitive segment in the peptide chains are arranged ah and that leads to the alpha
helix or beta pleated seat ah then we talk about the tertiary structure ah and finally
ah we talked about the quaternary structure ah i will like to stop here in today's
class we will again ah continue ah with the you know ah you know biomolecules ah you know
lecture ah in the next class thank you very you