निर्माण प्रबंधन (Construction Management) के सिद्धांत

[Nirman prabandhan (Construction Management) ke Siddhant]

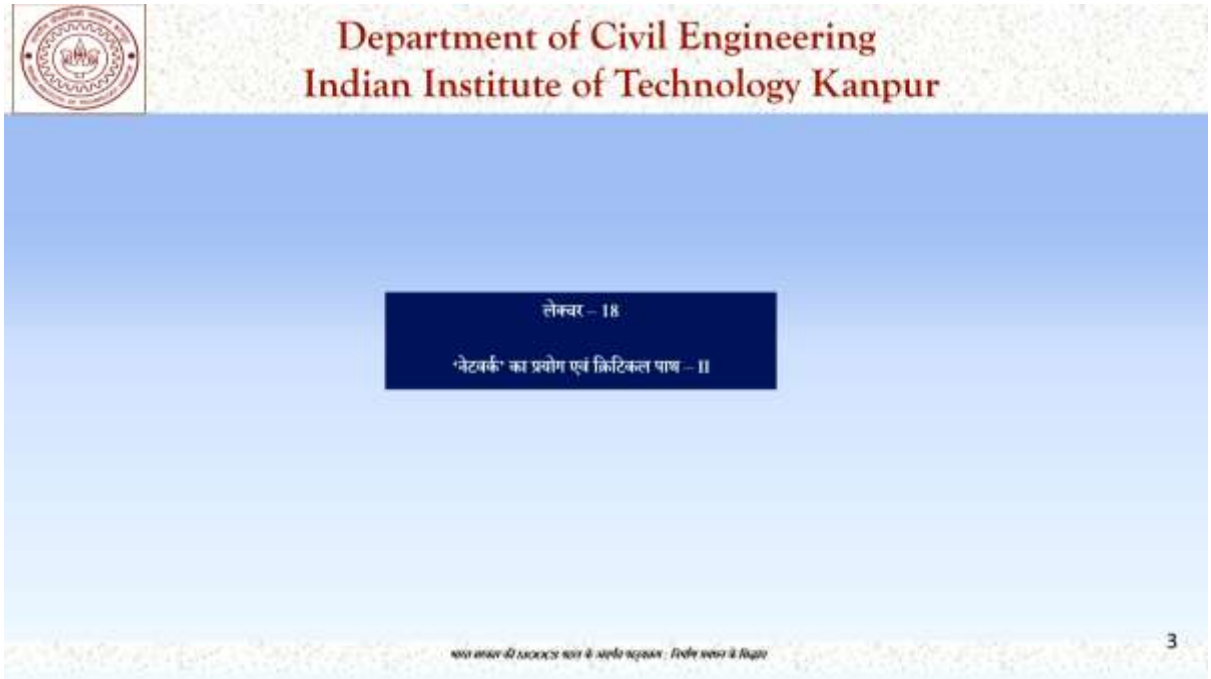
Prof. Sudhir Misra & Chirag Kothari
Department of Civil Engineering
Indian Institute of Technology – Kanpur

Lecture – 18

Network ka prayog evan critical path – II

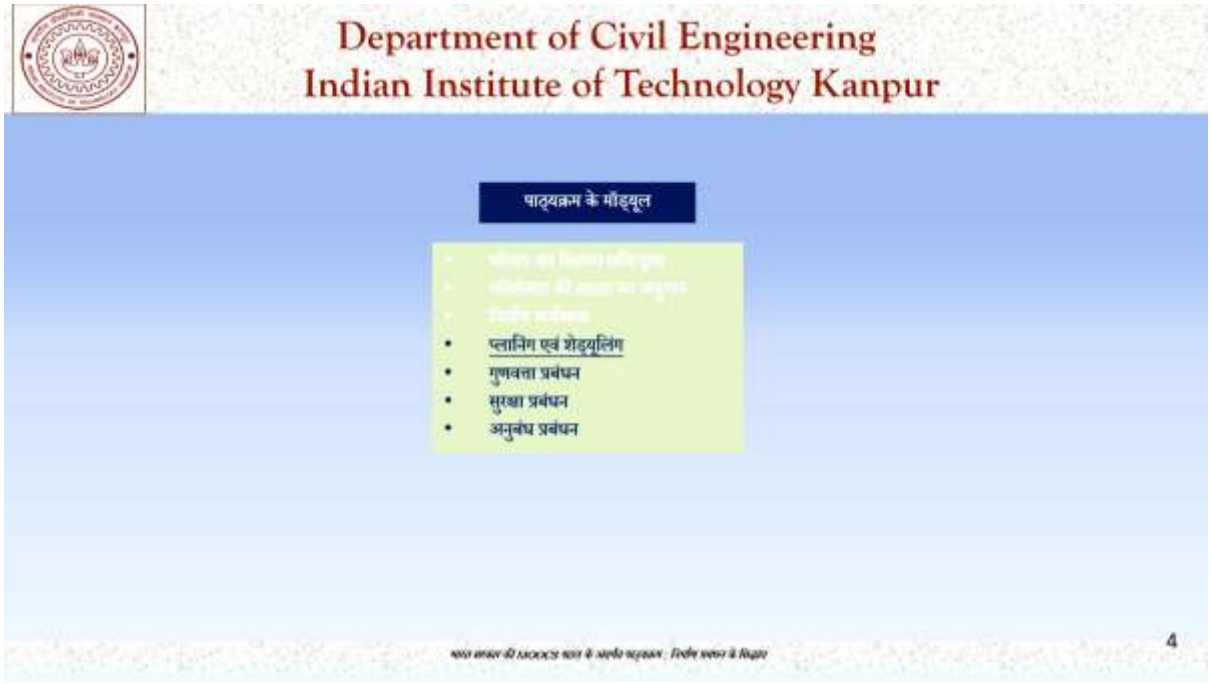
Namaskaar aur aapaka ek baar phir svaagat hai Bhaarat sarakaar kee moocs pahal ke antargat paathyakram Nirmaan Prabandhan ke Siddhaant (Principles of Construction Management).

(Reference Time 00:23)



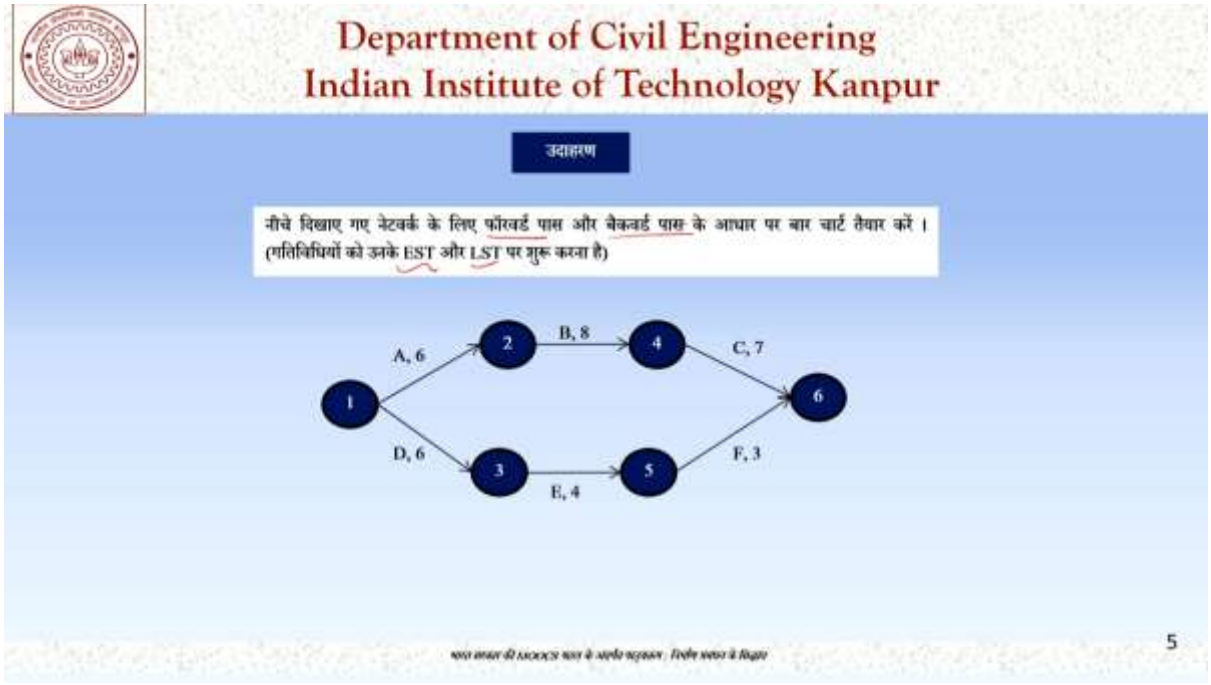
Ham log aaj hain lecture 18 par jahaan par ki ham network ka prayog evan critical path isaka doosara bhaag karenge.

(Reference Time 00:32)



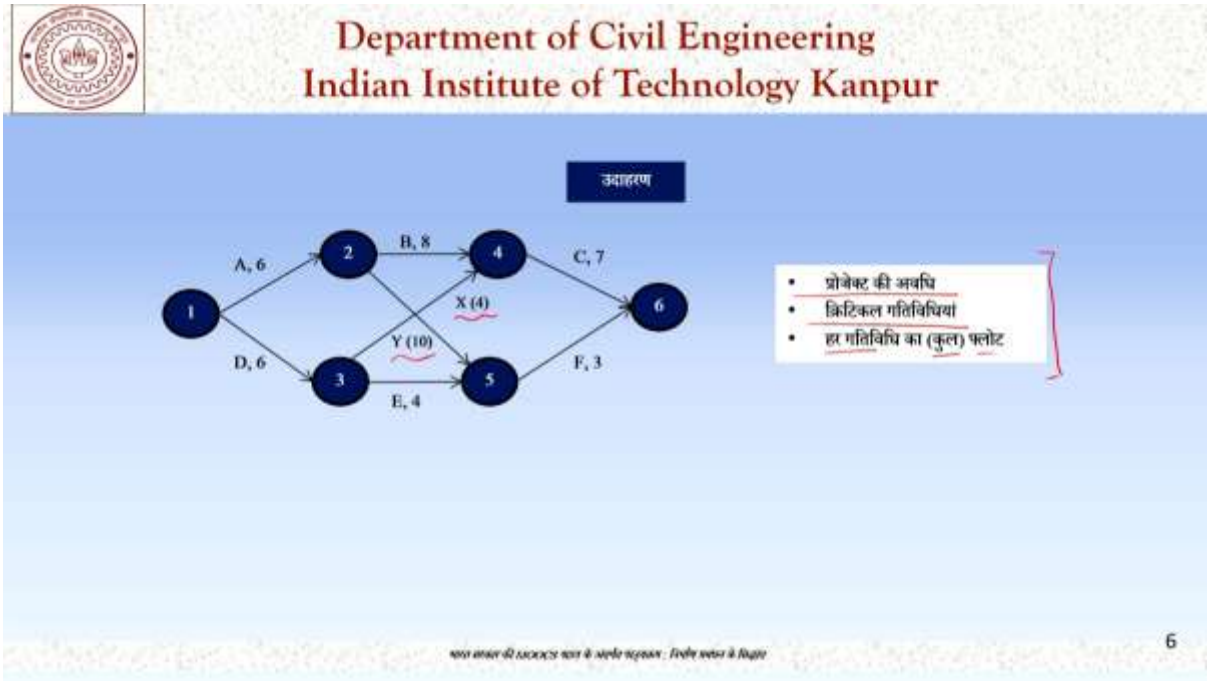
Yah hamaare paathyakram ke module hain aur ham log planning aur scheduling par charcha kar rahe hain.

(Reference Time 00:36)



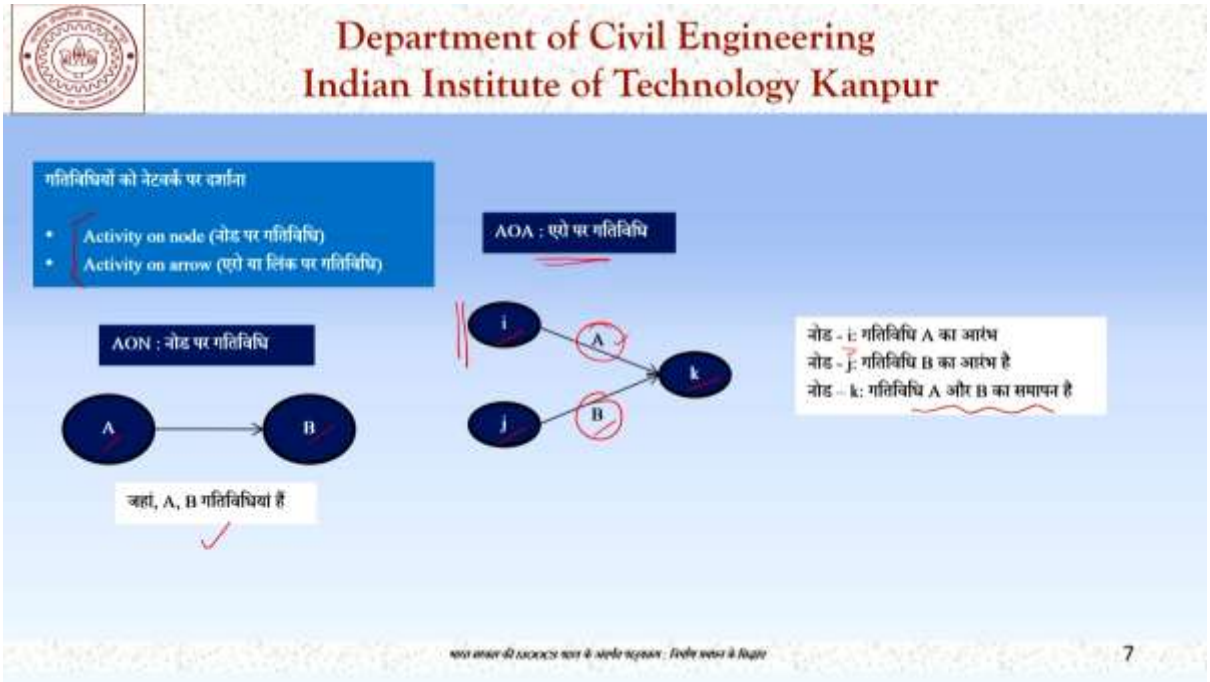
Aur pichhalee baar hamane is network ka vishleshan kiya tha. Hamane dekha tha ki 1 se lekar 6 node hain aur A, B, C, D, I, F yah chhah gatividhiyaan hai jo ki is prakaar se ek doosare par nirbhar hain aur unaka EST arthaat earliest starting time, LST arthaat latest starting time. Isako ham logon ne gyaat kiya tha forward pass aur backward pass ke maadhyam se.

(Reference Time 01:07)



Hamane aapako ek homework diya tha jisamen ki hamane kaha ki gatividhi X aur Y agar is prakaar se network mein jud jaatee hain unakee avadhi 4 din aur 10 din hai to ham project kee avadhi nikaalen, critical gatividhiyon ko chinhit karen aur har gatividhi ka kul yaniki total float nikaal len? Yah example ham aapako ek sheet ke maadhyam se forum mein upload kar denge ki aapane vah sahee kiya ya nahin kiya.

(Reference Time 01:39)



To ek baar phir ham ek revision karate hain aur hamane jab gatividhiyon kee baat kee thee to activity on node aur activity on arrow, yahaan par hamane kiya hai activity on node jahaan par ki A aur B gatividhiyaan hain jo ki node par dikhaaai gaee hain. Jab ham arrow par gatividhi dikhaate hain to is arrow par jahaan par ki node hain i, j aur k. To i ke gatividhi A hai aur j, k gatividhi B hai arthaat node i jo hai hamaara yahaan par vah gatividhi A ka aarambh hai, node j gatividhi B ka aarambh hai aur node k, A aur B donon hee gatividhiyon ke samaapan ka dyotak hai. Yahaan tak ham log charcha kar chuke hain.

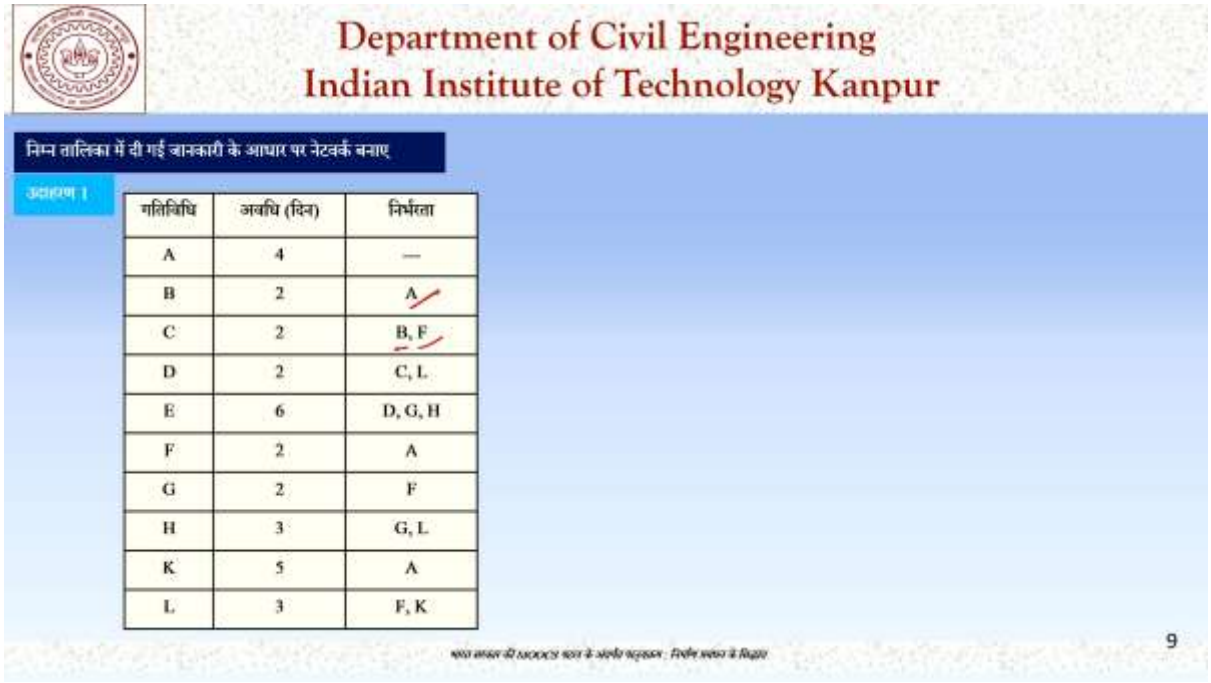
Isake aage aaj kee charcha mein main apane sahakarmee evan mitr Dr. Chirag Kothari ko aamantrit karoonga jo ki aapake networking ke siddhaant unake vishleshan aur nirbharata

taalika ke aadhaar par network kis prakaar banaaya jaata hai is par aapako thoda sa ek alag perspective denge aur main samajhata hoon ki aapako usase bahut laabh hoga to ham log aaiye sunate hain Dr. Chirag Kothari ko.

(Reference Time 02:57)

Namaskaar mera naam Chirag Kothari hai aur main IIT Kanpur mein Assistant Professor hoon. Yahaan se aage ka lecture main continue karoonga.

(Reference Time 03:09)

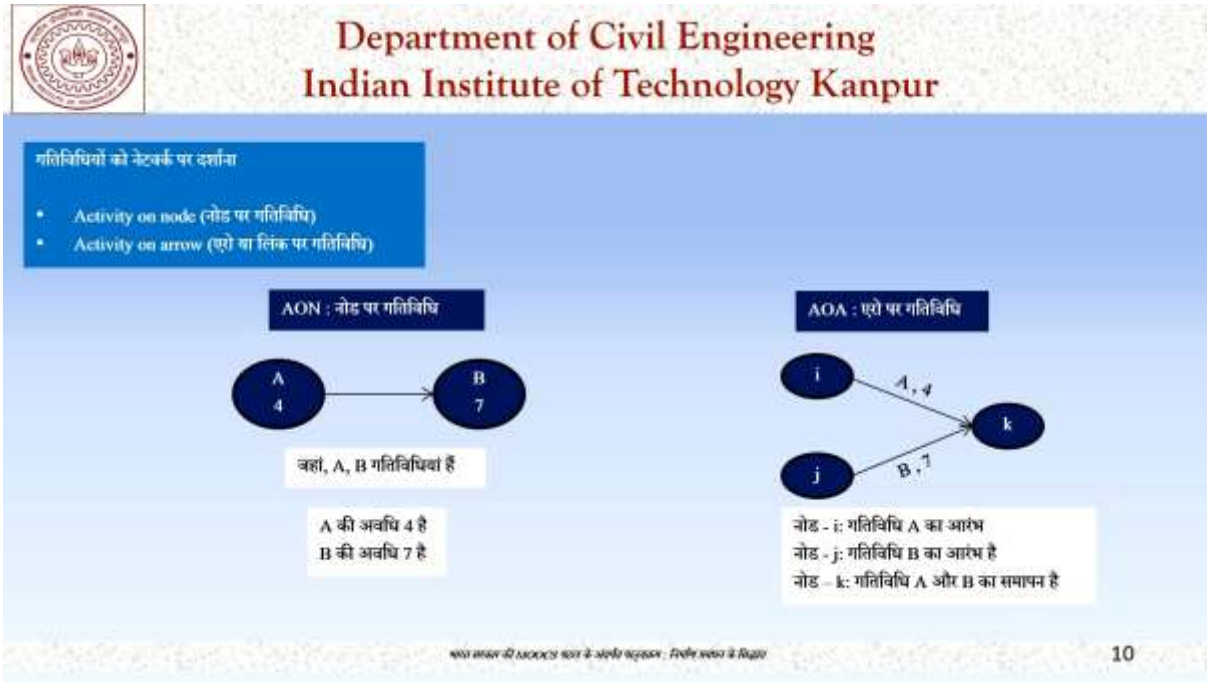


गतिविधि	अवधि (दिन)	निर्भरता
A	4	—
B	2	A
C	2	B, F
D	2	C, L
E	6	D, G, H
F	2	A
G	2	F
H	3	G, L
K	5	A
L	3	F, K

Ham dekhenge ki kis prakaar agar hamen ek nimn taalika dee gaee hai usakee jaanakaaree dee gaee hai to usake aadhaar par ham kis prakaar network bana sakate hain. Sabase pahale ham dekhate hain ki is taalika mein hamen kya jaanakaaree de gaee hai aap dekhenge ki pahale column mein likhee hain gatividhiyaan A, B, C se L tak. Yah gatividhi hain tatha doosare column mein hain unakee avadhiyaan. Yahaan likha gaya hai ki vah gatividhi kitane din legee poora hone mein aur teesare column mein dee gaee hai nirbharata, jo darshaatee hain ki ye gatividhiyaan kisee doosaree gatividhi par nirbhar to nahee hain. To yahaan par

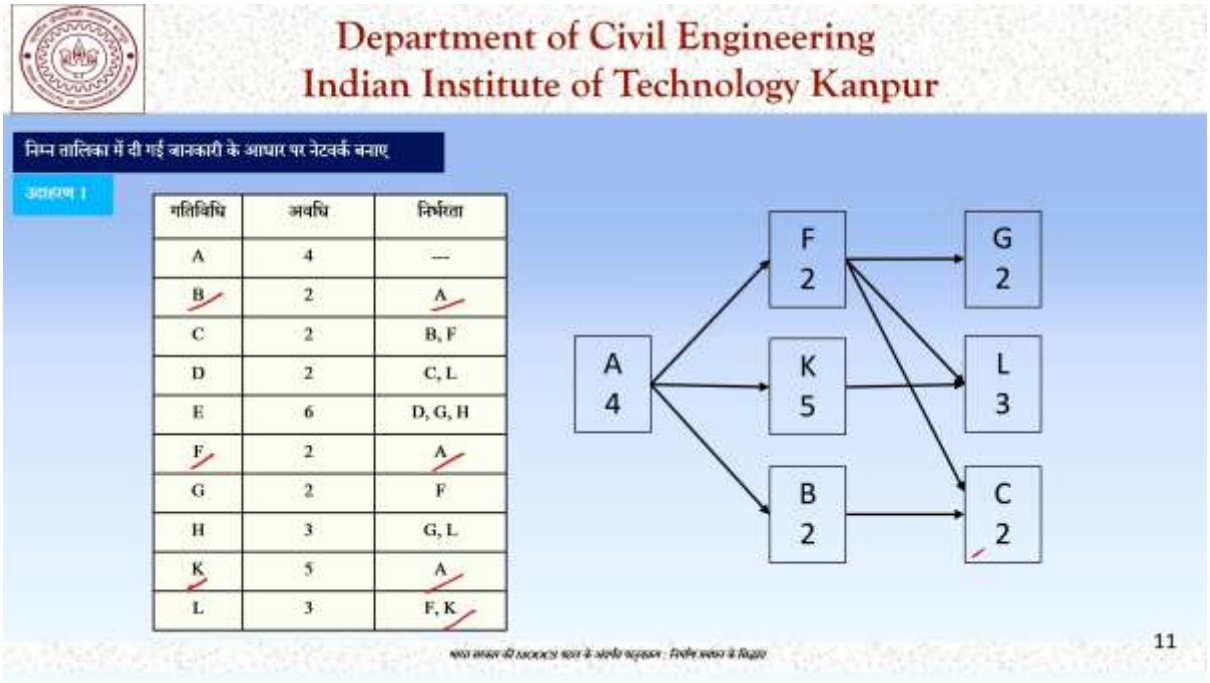
aap dekhenge ki agar B ke aage likha hai ki vah A par nirbhar hai isaka taatpary yah hai ki B ke shuroo hone ke pahale jarooree hai ki A poorn ho jaaye. Usee tarah C ke shuroo hone ke pahale jarooree hai ki B aur F poorn ho. Is prakaar in saaree nirbharataon ka dhyaan rakhate hue hamen network diagram banaana hota hai.

(Reference Time 04:14)



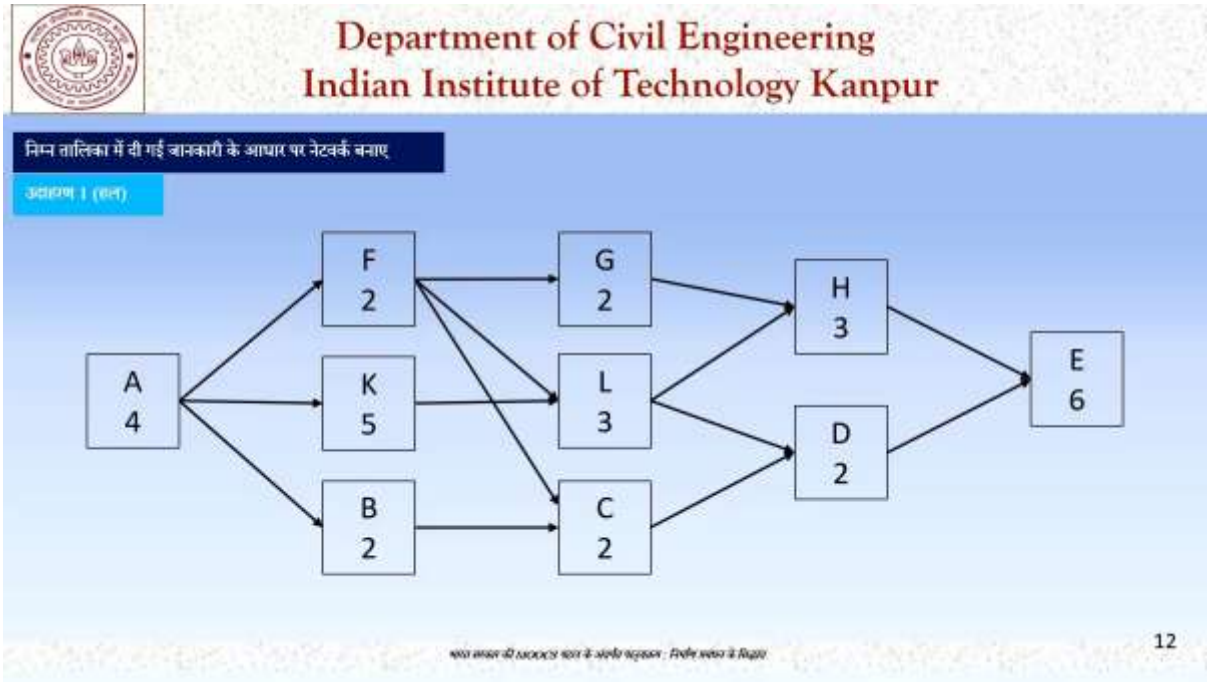
Aapane abhee dekha ki network diagram banaane ke do tareeke possible hain. Pahala activity on node jahaan par ham activity ko node ke andar likhate hain aur yahaan par aap dhyaan deejiega mainne jo unakee avadhi hai unhen bhee usee node ke andar likha hai. Doosara tareeka hota hai activity on arrow jahaan par arrow par gatividhi likhee jaatee hai jahaan i, j, k nodes hain aur activity A jo ki 4 din kee hai vah i aur k node ke beech mein hotee hai. Yah do tareeke hote hain. Aaj ke lecture mein ham arrow on node ka prayog karenge aur dekhenge kis prakaar ham network diagram bana sakate hain.

(Reference Time 04:56)



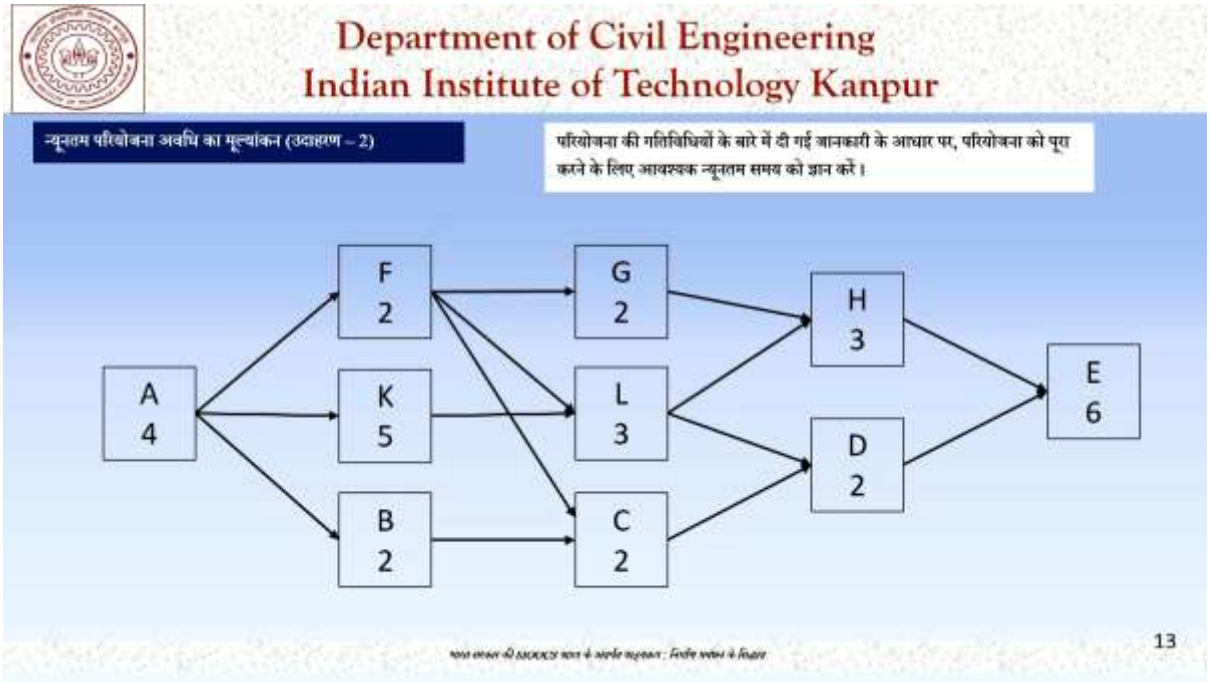
Aage badhate hain is tarah kee taalika hamen dee gaee hai sabase pahale ham vah gatividhiyaan likhenge jo kisee par bhee nirbhar nahin karatee hai. To sabase pahale hamane likha A aap chaahen to node circle bana sakate hain ya square bana sakate hain. Usake andar ham likh rahe hain avadhi jo hai 4 din. Ab ham aage chalenge aur ham dekhenge aisee kaun C gatividhi hain jo A par nirbhar hai to yahaan aap dekhenge B A par nirbhar hai, F vah bhee A par nirbhar hai aur K vah bhee A par nirbhar hai. To ab ham yah teenon gatividhiyon ko likhenge to F, K aur B aur unakee jo avadhi hain 2, 5 aur 2 vah aa gaee aur phir ham arrow kee madad se inhen join karenge. Ab ham dekhenge aisee kaun see gatividhiyaan hai jo F par nirbhar hain? To yahaan par aap dekhenge ki C jo hai vah F par nirbhar hai, G jo hai vah bhee F par nirbhar hai aur L jo hai vah bhee F par nirbhar hai. To ham vah teen gatividhiyaan isake baad banaenge. G, L aur C aur ham arrows join karenge. To sabase pahale F se hamane teen arrow join kiye hain, saath hee saath hamen dhyaan rakhana hoga ki yah kuchh gatividhiyaan K par bhee depend kar rahee hain to un gatividhiyon ka bhee ham arrow banaenge. To L jo hai vah hamaara K par nirbhar kar raha hai isalie ham K se L par ek arrow banaayenge. Ab ham C dekhenge, C aap dekhenge B aur F par nirbhar kar rahee hain. To B se bhee ham ek arrow banaenge. Isee prakaar aap aage badhenge aur poora network diagram banaayenge. Is video mein aage badhane ke pahale yah network diagram aap ek baar khud se banaen aur agalee slide mein die hue network diagram se compare karen.

(Reference Time 06:53)



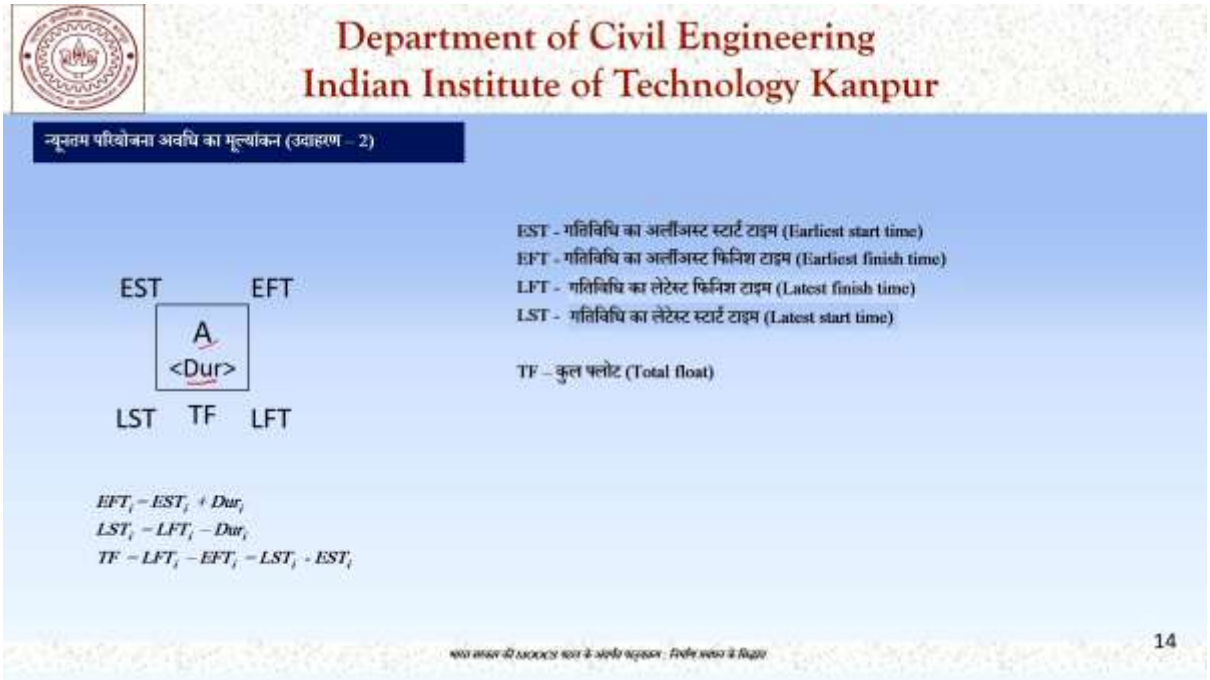
Ummeed karate hain aapaka network diagram kuchh is prakaar dikh raha ho. Ab ham isake agale bhaag par chalate hain.

(Reference Time 07:01)



Agale bhaag mein ham jaanenge ki agar hamen har gatividhi kee avadhi pata hai aur usaka network ya unakee nirbharata pata hai to ham kis tarah nyoonatam pariyojana avadhi ka moolyaankan karenge.

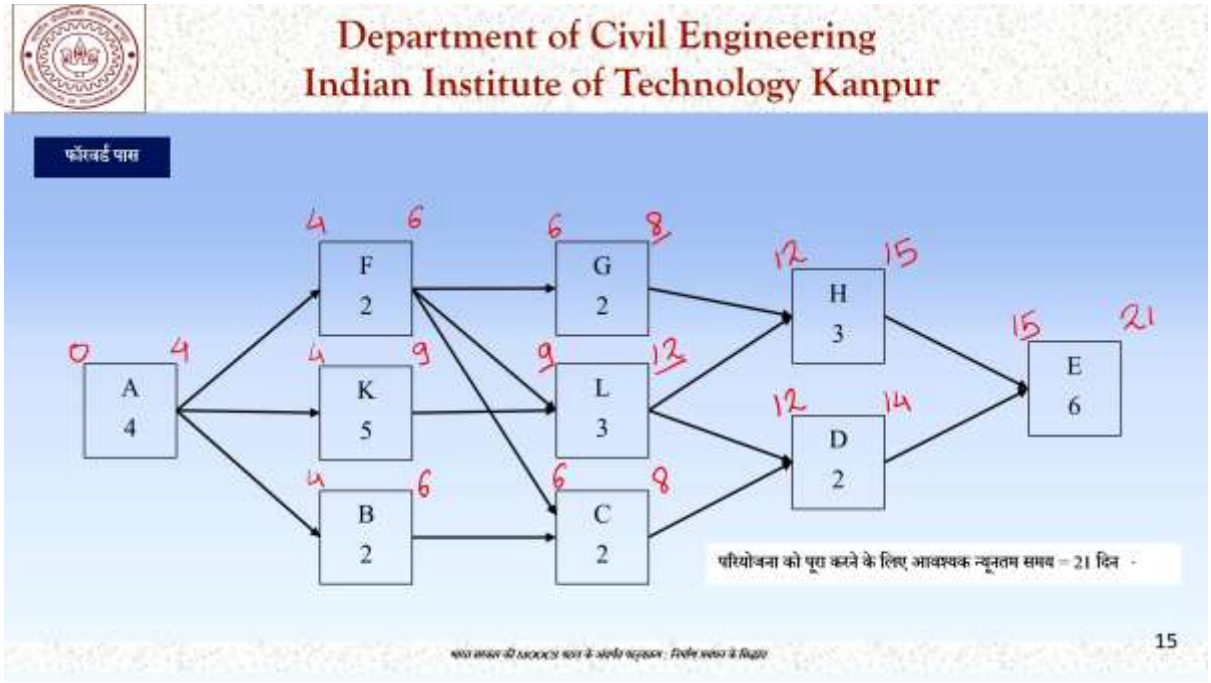
(Reference Time 07:17)



Use shuroo karane ke lie main aapase pahale ek legend discuss karana chaahata hoon ki ham kis prakaar use likhenge. To abhee tak hamane dekha ki ham activity ko node ke andar likh rahe hain jo yahaan par hai activity A jo hamane likha hai usakee avadhi jo hai vah ham node ke andar likh rahe hain aur isake baad jo hamaara pahala tarm hoga vah hai EST jise ham kahate hain gatividhi ka earliest start time. Vah ham is box ke baen haath ke oopar kee or likhenge. Usake baad jo hamaara earliest finish time hai EFT jo ki calculate hota hai EST plus usamen duration add karane se use ham daen haath par oopar likhenge. Jab ham backward pass karate hain to hamen sabase pahale milata hai LFT jise ham latest finish time kahate hain aur jab usamen se ham duration ko ghataate hain to hamen LST milata hai jise ham baen haath par neeche likhenge. Isake baad aakhiree mein ham total float nikaalenge jo

hota hai LFT minus EFT ya phir LST minus EST jise ham is box ke neeche madhy mein likhenge. To yah hamaaree key rahegee jise ham abhee udaaharan ke vakt use karenge.

(Reference Time 08:33)



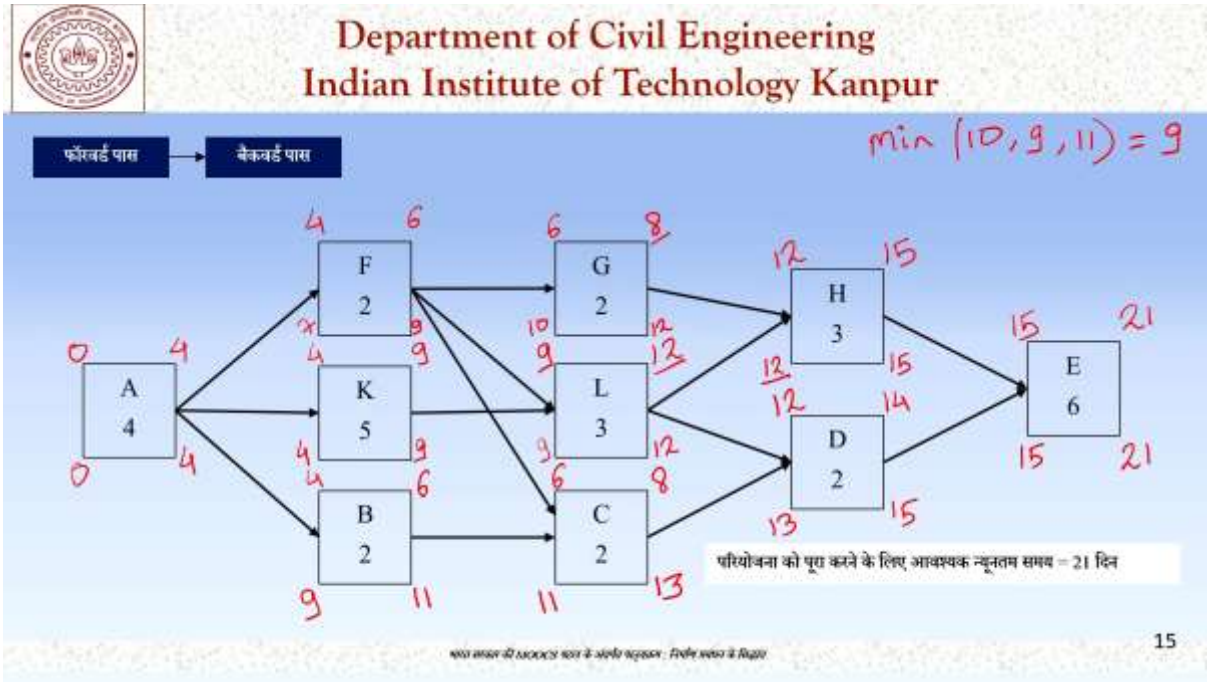
Ab ham chalate hain udaaharan par yah hamaare pass ek network diagram hai sabase pahale ham forward pass karenge. Jis tarah aapane pichhale lecture mein dekha forward pass se ham EST aur EFT nikaalate hain. To dekhie kaise shuroo hota hai yah. Pahalee jo activity hai ya pahalee jo gatividhi hai usaka EST ham 0 lete hain ya zero lete hain usake baad usakee jo duration hai ya avadhi hai use ham usamen add karate hain jodate hain aur vah yahaan likhate hain to 0 plus 4 hua 4. Ab jo hamaaree agalee activity hain F, K aur B ye teenon A par nirbhar kar rahe hain. To inakee shuruaat ka jo EST hoga vah isake EFT ke equal hoga. To yah ho jaega 4, yah hua 4 aur yah hua 4. Isaka taatpary yah hai ki jo activity F hai vah sirph activity A ke poorn hone ke baad hee shuroo ho sakatee hain. Jo ki hamaaree activity A chauthe din par pooree ho rahee hai isalie F, K aur B jo hain vah chauthe din par shuroo ho sakatee hain. Ab F activity ka ham EFT nikaalenge. EFT hoga 4 plus 2 duration vah hua 6 hai. Usee prakaar yah hoga 4 plus 5 jo hua 9 aur 4 plus 2 is equal to 6. Is prakaar hamane nikaal liya in teen activity isaka EFT.

Ab ham aage badhate hain ham chalate hain agalee activity par jo hai activity G. Aap dekhenge G sirph F par nirbhar hai, to jis tarah hamane dekha isaka bhee EST hoga 6. Agar ham aate hain activity L par, yahaan par aap dhyaan deejiega activity L jo hai vah do activities par nirbhar hai activity F par aur activity K par. Aapane pichhale lecture mein dekha ki ham is tarah jab bhee hamaare pass situation aatee hai to maximum lete hain adhikatam lete hain. To 6 aur 9 ka adhikatam hua 9, to yahaan par activity L ka jo EST hai vo 9 rahega aur ham usee tarah jab activity C par aayenge to 6 jo activity F hai aur B jo hai activity jisaka bhee EFT 6 hai un donon ka max phir se 6 hoga to vah yahaan hai. Ab ham inaka EFT nikaalenge jo hoga 6 plus 2 is equal to 8, 9 plus 3 is equal to 12 aur 6 plus 2 is equal to 8.

Ab ham aage badhate hain activity H kee taraph. Activity H aap dekhenge G aur L par nirbhar hai. G ka EFT hai 8, L ka EFT hai 12. Hamane dekha ki ham in donon ka adhikatam lenge. Adhikatam lene ke peechhe taatpary yah hai ki H activity sirph G aur L ke khatm hone ke baad hee shuroo ho sakatee hai jo ki activity L jyaada avadhi le rahee hai aur vah 12ven din khatm hogee isee lie activity H sirph 12ven din ke pahale chaaloo nahin ho sakatee. Isee lie activity H 12ven din par shuroo hogee. To yahaan aaega 12, 12 plus 3 hua 15. Ab neeche aate hain activity D dekhenge. Activity D C, C aur l par nirbhar hai to yahaan se 12 aur 8 ka

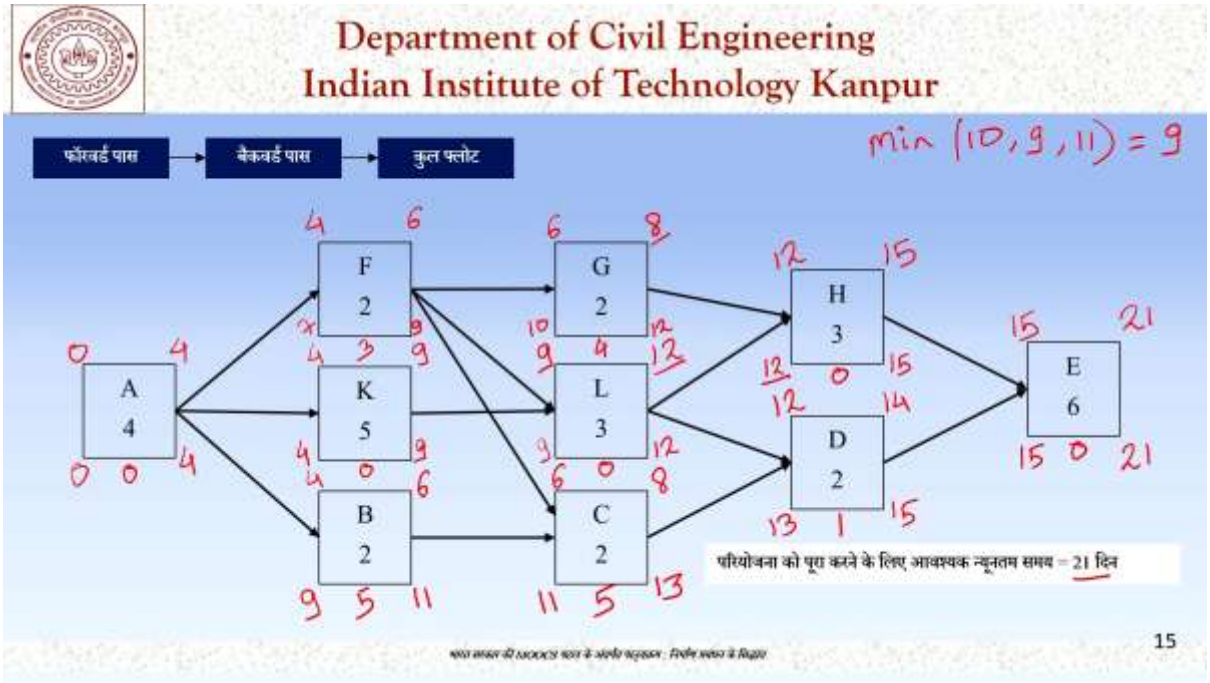
jo max hua 12 vah aaega. 12 plus 2 ham karenge 14. Ab jab last activity I par ja rahe hain to same cheej 15 aur 14 ka max adhikatam dekhenge jo hai 15 aur usamen ham 6 jodenge to 21. Is prakaar ham dekhenge ki is poore project ka maximum din jo chaahie complete karane ke lie vah hai 21 din. Is prakaar hamen activity I ka EFT mila 21 din jo ki hamaaree activity I aakhiree activity (gatividhi) hai us kaaran pariyojana ko poora karane ke lie aavashyak nyoonatam samay hua 21 din, yah kahalaata hai forward pass.

(Reference Time 12:40)



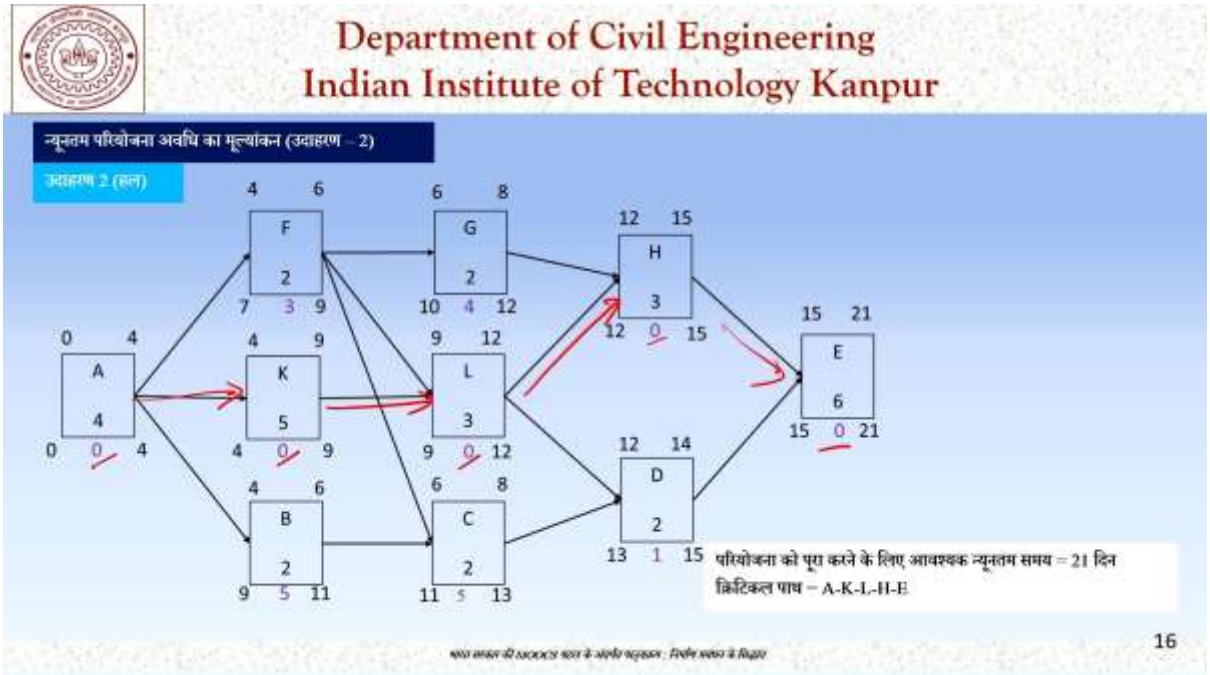
Isake baad ham LST aur LFT kaise nikaalate hain vah dekhenge jo ki hota hai backward pass. Backward pass kuchh is prakaar hota hai. Sabase pahale jo aakhiree activity hai usaka yah EFT jo hai vahee hamaara LFT hota hai. To yahaan par ham likhate hain 21 din. 21 mein se 6 ko ham ghataenge to vah aata hai hamaara 15 din. Ab ham pahale jaate hain activity H dekhenge, activity H I par nirbhar kar raha hai aur yahaan par 15 hai to yahaan par 15 aata hai jo hamaaree activity I hai usaka jo LST hoga vah usaka poorv jo activity hai usaka LFT hoga. Usee tarah yahaan par bhee hoga 15. Ab ham 15 mein se 3 ghataenge to H ke lie yah hamen milega 12 aur 15 mein se 2 ghataenge to D ke lie hamen yah milega 13. Ab ham activity G par aate hain. Aap dekhie G H se juda hai aur kisee activity se nahin juda hai to activity G ka LFT bhee hoga 12 jo ki yahaan se aaya. Ab aap neeche aaiye activity L, activity L par aap thoda dhyaan deejiega yah H aur D do activity se juda hai. Jahaan par H ka LST hai 12 aur D ka LST hai 13. Hamane pichhale lecture mein dekha ki is samay ham minimum jo nyoonatam hota hai vah lete hain. To 12 aur 13 ka jo nyoonatam hoga 12 vah yahaan par ham lenge aur activity C jo ki sirph activity D par nirbhar hai usaka yahaan par ham directly 13 le sakate hain. Ab ham inaka LST nikaalenge jo hoga 12 mein se 2 ghataaya 10, 12 mein se 3 ghataaya 9 aur 13 mein se 2 ghataaya 11. Ab ham ek aur step peechhe chalenge ham aate hain F par. Ab aap F dekhenge to vah G se, L se aur C se teen gatividhiyon se juda hua hai. Yahaan par ab hamen minimum lena hoga minimum of nyoonatam ham lenge kis-kis ka 10, 9 aur 11 in teenon ka nyoonatam hota hai 9, to yahaan par aaega 9. Jo hamaaree gatividhi K hai vah sirph L se judee huee hai to yahaan par ham seedha 9 likh sakate hain aur activity B jo hai vah C se judee huee hai isalie yahaan ham seedha 11 likh sakate hain. Ab ham chalate hain in teenon activities ke LST kee or LST hoga 9 mein se 2 ghataaya 7, 9 mein se 5 ghataaya 4 aur 11 mein se 2 ghataaya 9. Ab ham aate hain pahalee activity kee taraph. Pahalee activity phir se F, K aur B se judee huee hai in teenon activities ka LST 7, 4, aur 9. Ham in teeno ka nyoonatam minimum lenge jo hai 4 aur usake baad ham 4 mein se 4 ghataayenge to 0 aayega. Yah hamane dekha ham kis tarah backward pass nikaal sakate hain. To ab hamen sabhee gatividhiyon ka EST, EFT LST aur LFT mil gaya hai.

(Reference Time 16:08)



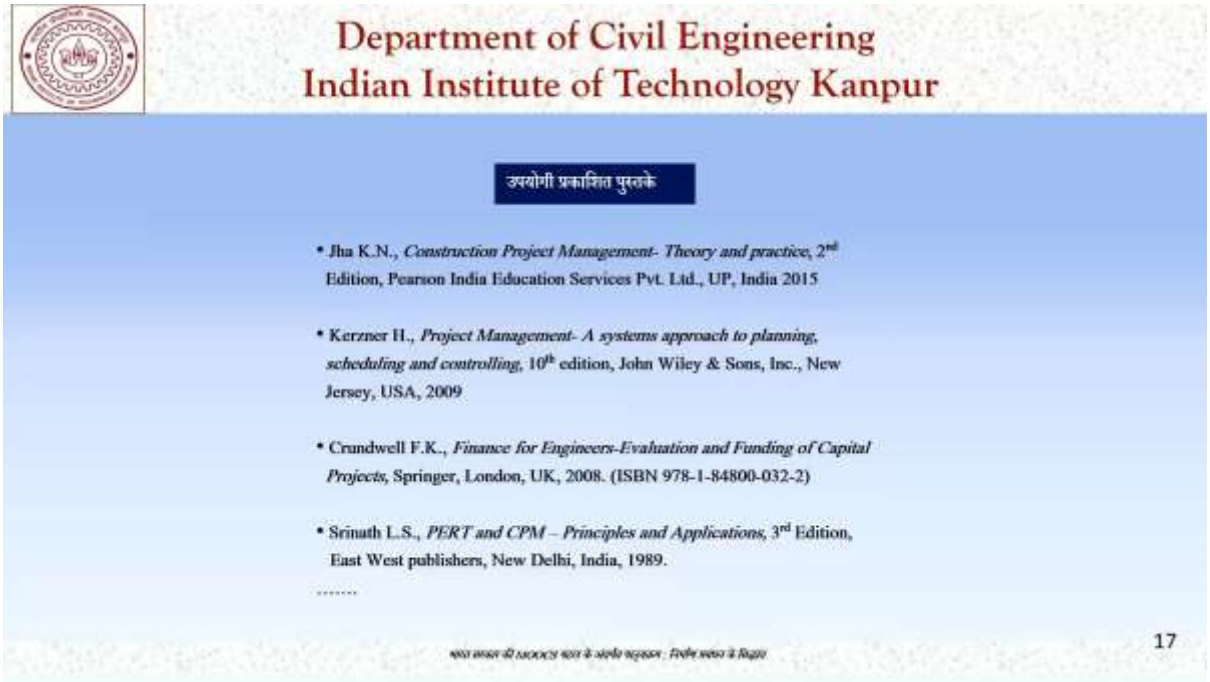
Ham aakhiree step par aate hain jo ki hai kul float (total float). Total float hota hai ki koai bhee gatividhi kitane din se deree kee ja sakatee hai bina poore project ko late kare. Kul float nikaalane ka jo simpal tareeka hai vah yah hai ki ham LST mein se EST minus karen ya phir LFT mein se EFT minus karen. To yahaan par ham dekhenge to A ka total float hua 0 mein se 0 ghata 0 ya 4 mein se 4 ghata 0. Usee tarah F mein hoga 7 minus 4, 7 mein se 4 gaya 3. K mein hoga 9 mein se 9 gaya 0 aur yahaan par aakhiree mein hoga 9 mein se 4 gaya 5. Isee prakaar G mein hoga 4, l mein hoga 0 aur C mein hoga 11 mein se 6 gaya 5. H par aaenge to vah hoga 12 mein se 12 gaya 0. D par aaenge to hoga 13 mein se 12 gaya L ya phir 15 mein se 14 gaya L. Aur aakharee I par aate hain to yah hoga shoony. Jab total float ya kul float shoony hai isaka arth hai ki in gatividhiyon ko ham deree nahin kar sakate hain. Inakee deree karane se jo total project hai usakee avadhi 21 din se jyaada ho jaegee. Isee lie vah saaree gatividhiyaan jinaka total float zero hai unhen ham critical path par maanate hain.

(Reference Time 17:40)



To yahaan par aap dekhenge ki critical path hoga hamaara A jahaan par total float 0 hai, K jahaan phir se 0 hai, L jahaan phir se 0 hai, H aur I to yah jo hamaara paath hai A se K, K se L, L se H aur H se I. Yah hamaara critical path hoga. To is network path ka critical path hua A, K, L, H aur phir I. To aaj hamane dekha ki kis tarah ham agar hamen taalika dee gaee ho to usase network diagram arrow on node method use kar ke bana sakate hain. Kis prakaar ham forward pass, backward pass aur total float ka moolyaankan kar sakate hain aur phir kis prakaar ham critical path ko identified kar sakate hain. Is prakaar agar aapako kisee bhee project kee alag-alag gatividhi dee gaee hai unakee avadhi pata hai aur vah kis prakaar ek doosare par nirbhar hai yah pata hai to aap usaka ek network diagram bana sakate hain aur nikaal sakate hain ki aavashyak nyoonatam samay kitana hoga aur kaun C gatividhiyaan critical path par rahegee.

(Reference Time 18:51)



Yah kuch references hai aur aaj ham yah lecture yaheen par samaapt karenge. Bahut-bahut dhanyavaad!