Robotics
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Lecture – 09
Introduction to Robots and Robotics (Contd.)

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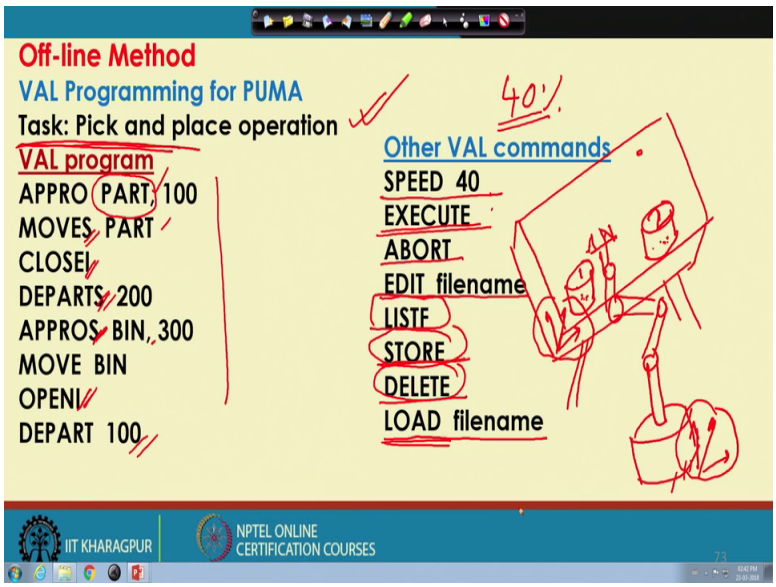

Now I am just going to write down the VAL programming to solve the task that is pick and place type of operation, and I have already defined the position and orientation of this particular 3 d object and that is nothing, but the part. Part is actually that particular the name of the 3 d object, and this particular part is here on this particular you are the bucket number 1 or the bin number 1 the tasks of the robot will be.

So, this end effector or the gripper, so it will come to bin 1 it will grip that particular object and it will carry it to this particular bin 2 and it is going to place it there, and for that I am just going to write down this particular the VAL programming.

So, the first command is you are APPRO part comma 100 part is actually the name of that particular 3 d object. So, if I write down APPRO part comma 100; that means, your this part is defined its position and orientation are defined.

So, this particular end effector, so it will come to a position which is 100 millimeter above this particular part in the z direction and it will stop there, the next command is

your moves part, s means straight path. So, from here, so it will move to the part by following a straight path and it is going to reach that particular item that is part then CLOSEI. So, with the help of this particular end effector or the finger, so it is going to grip that particular the object and I means there will be a short delay.

So, I indicates short delay, so now, this particular end effector has already gripped that particular object whose name is part. The next command is departs 200 s is once again its stand for straight. So, from here, so depart by 200 millimeter along this particular the z direction. So, by default this particular movement is along the z direction, then APPROS BIN comma 300 s means the straight path. So, from here you approach a particular point by following a straight line to a point and that point is actually 300 millimeter above this particular your 300 millimeter above your BIN that is your BIN 2.

So, here I am here, so I am actually at the top of that particular the BIN then move BIN. So, this particular end effector will move to this particular BIN and once it is move this particular BIN, next is your OPENI; that means, you un grip that particular object you release the object and I means there will be a short delay. And once it has un gripped now it will depart in the z direction by 100 and that is nothing, but depart 100.

So, that completes actually the VAL programming to solve this particular task that is your pick and place type of operation. So, this is the way actually we can write down the program the VAL programming just to teach a particular the robot. Now here I am just going to tell regarding some other VAL commands, which are also used along with this for example, say we can mention this speed. The speed of movement now here if I write down speed 40 means the speed will be 40 percent of the rated speed or the maximum speed.

So, actually at each of the joint we have got the motor and the motor is having the maximum rated speed. So, speed 40 means it will take 40 percent of the maximum rated speed. Now execute is actually the command if you want to run this particular program abort is another if you want to stop running that particular now edit filename. So, if we write down edit then blank filename, so that particular readymade program which is the already stored there. So, that will come on the display and now you can add a few lines you can delete few lines, you can save it that is using this particular command that is store.

So, by store this particular command we can save that particular the program then LISTF is the listing of the file, supposing that there are a few files which are stored in the program and if you want to see the listing of that particular files. So, we can use this particular command the next is your DELETE. So, we can DELETE a line we can DELETE program with the help of this particular the DELETE, next is your load blank filename. So, if I write down load blank filename, so with the help of this particular command actually we can we can we can load the program on the display and there we can add a few new lines, we can delete a few lines and after that we can save it we can execute and we can run this particular the robot.

Now, here I just want to mention one thing that I have discussed the different the robot teaching method for the purpose of robot teaching methods is to just to give a particular command some specific command to solve a particular task and purpose is not to make it intelligent. So, by teaching we cannot make a robot intelligent and to make it intelligent actually we will have to do something else, which I am going to discuss at the end of this particular the course and once again let me repeat the purpose of teaching is just to give instruction, but not to make it intelligent. Now, actually I am just going to concentrate on how to prepare the specification of a particular the robot.

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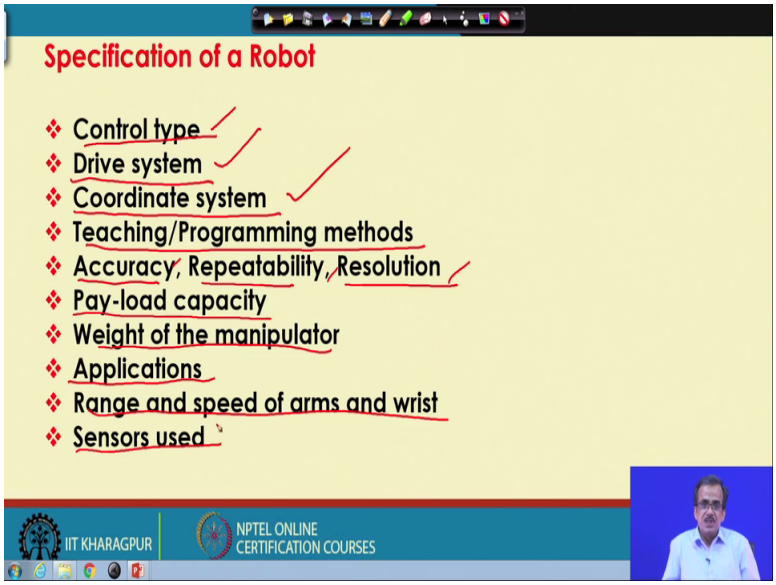

Supposing that I am just going to purchase a robot to solve some specific purpose to solve some specific purpose, now if I want to purchase a robot so, what are the different

information which I we will have to give which I have to specify while preparing that particular the specification. So, those things I am just going to mention one after another for example, say.

So, I will have to mention about the control type ah; that means, you're whether I should go for the servo controlled robot or non-servo controlled robot. So, that I have already discussed, so non-servo controlled robot means your that is you will not be getting very accurate movement, and if I want to get very accurate movement we will have to go for actually the servo controlled robot. So, the control type we will have to mention.

The next is you're the drive system now; that means, we will have to mention that whether we are going for the pure mechanical drive like the gear drive or chain drive or bell drive or we are going for some sort of hydraulic drive, pneumatic drive, electro hydraulic, drive electro, pneumatic drive. So, that particular drive system we will have to clearly mentioned, the next is the coordinate system like whether it is Cartesian coordinate robot or cylindrical coordinate robot or spherical coordinate robot or a revolute coordinate robot that we will have to clearly mentioned in the specification.

The next is you are the teaching or the programming method how can it teach a robot which method I am going to use. So, that we will have to mention, the next is ypu are the accuracy repeatability and resolution we know the meaning of these particular terms and if I want to purchase a robot. So, clearly we will have to mention how much resolution you want what is the accuracy and repeatability you want the next is actually the pay load capacity.

Now, depending on the pay load capacity actually we will have to find out how much should be the joint talk how much is the capacity of the motor and others those things I will be discussing after some time. So, this pay load capacity is actually the, what is the maximum amount of load that can be carried at the end effector of this particular the robot. So, that we will have to clearly mention then comes you are the weight of the manipulator. So, we will have to mention what should be the weight and accordingly actually we will have to think about the foundation of this particular the robot also.

Next is the application the purpose for which we are going to use this particular the manipulator the range and speed of arms and wrist. So, that we will have to specify what should be the range of movement of the different joints and what should be the speed of

this particular movement and what should be the workspace the those things actually we will have to find out beforehand.

Next is if I want to make it intelligent, so we will have to use some sensor which I have not yet discussed and that particular sensor we will have to select, how to select what are the different types of sensors to be used. So, those things I am going to discuss after some time. So, this is actually how to prepare that a specification if I want to purchase that particular the robot.

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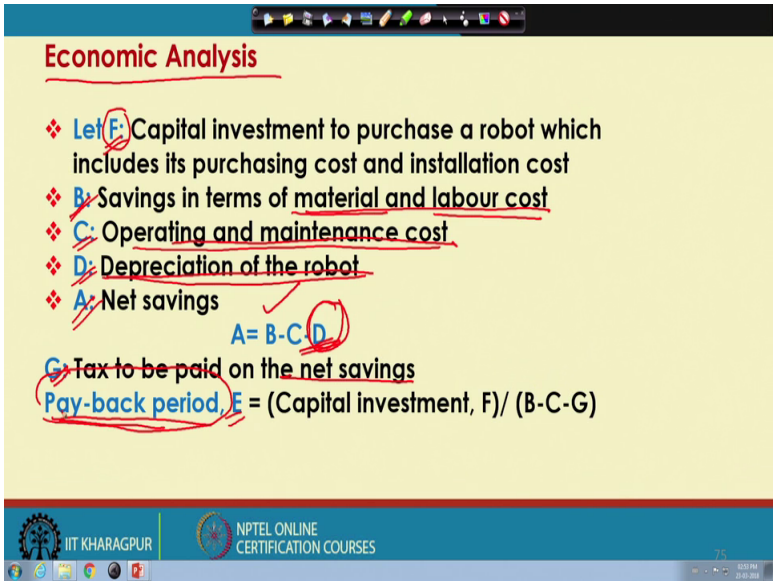

Now, I am just going to carry out one economic analysis now before just go for this particular economic analysis let me tell the purpose behind going for this particular the economic analysis. Now we have understood that modern manufacturing unit should keep some robot and moreover the robots are having some other type of applications. Now a particular manufacturing unit if it once to purchase a robot, robot is costly like if we just go for today's very sophisticated serial manipulator having say 6 degrees of freedom the cost will be Indian rupees around 25 lakhs 20 lakhs something like that so it is costly.

So, this manufacturing unit is going to take one decision whether it should take a loan from the bank and purchase this particular robot or not. So, to take this particular decision, that whether I should take loan from the bank to purchase a robot for my own manufacturing unit. So, I will have to carry out some analysis and that is the purpose of

this particular the economic analysis. Now here actually I am just going to define a few terms and I am just going to take the decision at the end whether I should take loan from the bank to purchase a particular robot for my own manufacturing unit.

Now, here the symbol F indicates the capital investment to purchase a robot which includes the purchasing cost and installation cost. So, if I want to purchase a robot and install that particular robot. So, supposing that I will have to spend F amount of money, now this B indicates the savings in terms of material and labour cost. Now you have already discussed that if we can replace the human operator. So, there will be some saving in terms of labour cost and as the chance of rejection will be less. So, there will be some sort of saving in terms of material cost.

So, this particular B indicates the savings in terms of material and the labour cost, the next is your C that is nothing, but the operating or the maintenance cost for this particular robot there will be some operating and the maintenance cost, the next is D which indicates the depreciation of this particular the robot. So, by depreciation actually we mean the following value of an asset, now let me take one example supposing that if I purchase one car today by spending say rupees 5 lakhs. And if I want to sell it after 10 days I may not get rupees 10 lakhs in return provided the cost of that particular brand of the car remains the same.

So, I may get slightly less might be say 50000 or say 1 lakh less than the 5 lakhs, now this particular difference of 50000 rupees or 1 lakh that will be the depreciation value of this particular the car in 10 days now actually whenever we purchase the new machine. So, our maintenance cost is less and that is why we consider that initially there will be more depreciation and with the age of this particular car or the machine the maintenance cost is going to increase and this particular the depreciation is going to decrease. So, that the sum of the depreciation and the maintenance call remains more or less constant.

But here actually what I am going to consider for simplicity that the rate of depreciation is not varying, but generally we consider the varying rate for this particular depreciation, initially the rate of depreciation will be more and with time you are the rate of this depreciation will be less, but here for simplicity I am just going to consider the constant depreciation.

Now, next is you are A, A indicates the net savings now if I purchase the robot. So, there will be some saving in terms of material and the labour cost. So, A is nothing, but B minus C C is the operating or the maintenance cost minus D, D is nothing, but is your depreciation that I am going to subtract here and this particular depreciation value is going to help us in actually the tax calculation.

Now, actually what we do is whenever we calculate tax we have some standard deduction now that particular standard deduction is nothing, but is your some set of depreciation now here. So, we calculate the net saving by considering or by subtracting the depreciation value and here, so G is nothing, but the tax to be paid on the net saving. So, based on our saving certain percent of our saving or our income we pay as tax say 30 percent or 35 percent or something like that.

So, G is actually the total amount of tax to be paid on this particular the net saving now pay back period I am just going to define this particular term. So, this payback period is denoted by E and this is nothing, but the minimum amount of time required or the number of years required to get the money back for example, say while purchasing I have spent some money on the robot. So, how much time how much minimum time it will take in years to give me the money which I have spent to give me back. So, that particular time is nothing, but the payback period for a particular machine or the payback period for this robot.

And this payback period is defined as is calculated as capital investment which is denoted by F divided by B, B is nothing, but the total saving C is nothing, but the operating cost. So, B minus, C minus G, G is nothing, but the tax the amount of tax to be paid. So, this is the way actually we calculate this particular the payback period; that means, the years the number of years required to get that particular money back which I have spent.

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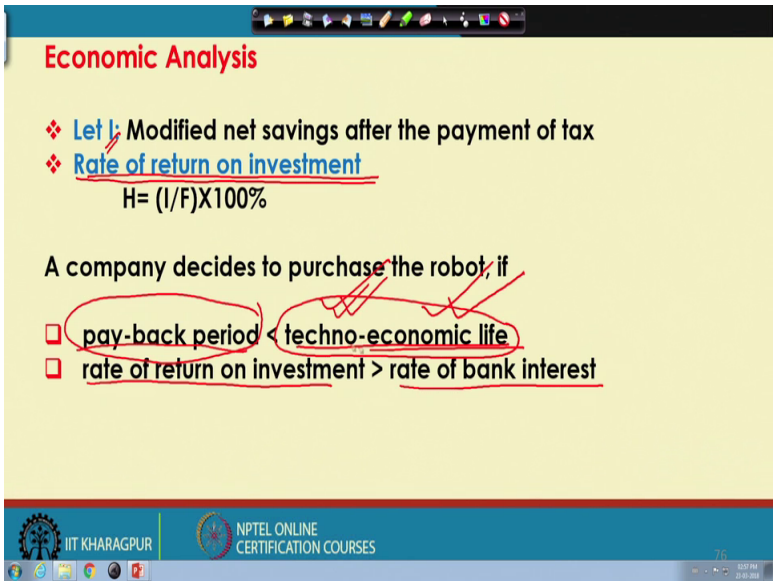

Now, once they have got this particular the payback period next we try to find out what should be the rate of return on investment, now to determine the rate of return on investment. So, what we do is supposing that based on my net savings my income say 30 percent or say 35 percent I have spent as tax, I have given as tax to the government. So, I am having the remaining 65 percent. So, that particular remaining 65 percent of my income is nothing, but is your I.

So, let I be the modified net saving after the payment of the tax, now if I is known. So, I can find out the rate of return on investment and that is nothing, but I divided by F multiplied by 100 in percentage and we will be getting some numerical value. And that is known as actually the rate of return on investment, now we compare the payback period with the techno economic life of the robot and this particular the rate of return with the rate of bank interest.

Now, here the first comparison is your payback period with techno economic life of the robot, payback period I have already defined. Now I am just going to define what do you mean by this techno economic life of a robot. Now this techno economic life of a robot is actually the intersection of your the technical life and the economic life. Now supposing that now by intersection we mean the minimum supposing that the technical life of a robot is a 10 years an economic life is a 6 years. So, the techno economic life will be your 6 years not 10 years.

Now, by technical life we mean the period up to which the robot can manufacture or the robot can produce goods within the technical specification, within the tolerance limit of this particular the product, that is known as the technical life and by economic life we mean the number of years during which the robot is going to manufacture within the profit zone. So, by using this particular robot in my manufacturing unit, so long as I am getting the profit. So, this particular robot is in economic life zone, so this is the way we try to find out the technical life of a robot, the economic life of a robot, and we try to find out the intersection and that is nothing, but the techno economic life.

And here the rate of return on investment I have already discussed and that has to be compared with the rate of bank interest now if I take loan from the bank. So, at the end of each year, so I will have to give by EMI. So, I will have to pay that particular and there will be some tax also some the bank rate of interest also and this particular year EMI I will have to pay and.

So, this particular rate of return on investment that has to be greater than the rate of bank interest and this particular payback period has to be less than the techno economic life then only we should go for purchasing that particular robot by taking a loan from this particular the bank. So, this is the way actually we will have to take the decision that whether we should purchase a robot by taking a loan from the bank.

Thank you.