Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY

I SEMESTER M.TECH. (INDUSTRIAL AUTOMATION AND ROBOTICS)

END SEMESTER EXAMINATIONS, NOV 2017

SUBJECT: Introduction to Industrial Robots [MTE 5102]

REVISED CREDIT SYSTEM (18/11/2017)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer any 5 questions.
- Data not provided may be suitably assumed
- 1A. Identify the joint notations for the following robots. Draw the work envelops and give an example for each of the configurations shown below.



1B. Determine the motion (i.e. x(t)) of a joint modeled by a spring mass system shown in Figure Q1B. Parameter values are m=1, b = 5, and k = 6 and the block (initially at rest) is released from the position x = -1.

m b Figure Q1B

- 1C. Describe features and capabilities of future industrial robots.
- 2A. One of the axis of a robot is a telescopic arm with a total range of 0.5 meter. The robot control memory has 8-bit storage capacity for the axis. Mechanical inaccuracies involved are as shown in figure Q2A. Determine-



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- **2B.** For an image digitized at 128 points per line and there are total 128 lines, Determine
 - a) the total number of bits required to represent greyscale values if an 8 bit A/D converter is used to indicate various shades of grey.
 - b) The reduction in data volume(bits) if only black and white values are digitized
 - *c)* If a complete white pixel is assigned highest grayscale value and a complete black pixel is assigned the lowest greyscale value, then what could be the cumulative greyscale value of the entire frame shown Figure Q2B.

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Figure Q2B

- **2C.** What are wheeled vehicles and walking machines? Explain the problems **03** associated with them.
- 3A. An industrial robot has a necessary repair time of 7 hours before starting a project. Considering the availability of an industrial robot to be 0.75, calculate the mean operating time of the industrial robot.
- **3B.** Obtain the Euler-Lagrange dynamic equation for the one link arm shown in the Figure Q3B.



- 3C. Discuss the mechanical design features associated with future robots. Write a os short note on 3D Machine Vision System.
- **4A.** Explain spatial resolution and different factors affecting it.
- 4B. Consider a Machine Vision System in which a continuous video signal is converted into a discrete signal for image processing. The range of the signal after amplification is 0 to 5 volts. The A/D converter has an 8-bit capacity. Determine the number of quantization levels, the quantization level spacing, the resolution and the quantization error.
- 4C. What are the advantages and disadvantages of direct drive robots? Explain 03 methods to overcome the disadvantages.
- 5A. What are the configuration parameters, performance & precision parameters and product maintenance parameters of industrial robot? Explain with suitable formulae.

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- 5B. In a machine vision system an analog video signal is generated for each of the 512 lines comprising the faceplate. The sampling capability of A/D converter is 100 nanoseconds (this is the cycle time required to complete the A/D conversion process for one pixel). If frame buffer has a capability to store digital images at 30 frames/second (American standard). Determine the scanning rate and the number of pixels that can be processed per line.
- 5C. Explain the different industrial objectives of future robots such as perception, 03 processing, power and planning.
- 6A. Define industrial automation. Give an example and explain the different types of industrial automation (in brief).
- **6B.** Suppose the gripper (shown in Figure Q6B) is a simple pivot type device used for holding a cardboard carton. The gripper force is 60 N. The gripper is to be actuated by a piston device to apply the actuating force F_a . Determine the actuating force under equilibrium.



6C. What are the characteristics of future robot tasks? Explain the assembly task and 03 Arc-welding task as per the future perspective.