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MANIPAL INSTITUTE OF TECHNOLOGY
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I SEM. M-Tech. INDUSTRIAL AUTOMATION AND ROBOTICS PG DEGREE END SEMESTER EXAMINATIONS
NOV 2015

SUBJECT: INTRODUCTION TO INDUSTRIAL ROBOTS (MTE 503)

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVEFULL** questions.
- Any missing data can be assumed suitably.

1A. Describe an ultrasonic transducer with single head system. Show the variations in transducer voltage with time graphically. **(03)**

1B. A Mechanical gripper with four fingers uses a friction grasp to hold the part of mass 7kg. The coefficient of friction between the part and gripper pad is 0.3. The diameter of the pneumatic cylinder and piston rod is 50mm and 20mm respectively. Assuming the factor of safety of 1.5 ,L1= 60mm ,L2 =40mm, L3=15mm, L4= 45mm. Refering to fig. 1, when the gripper is accelerating up with a = 10m/sec² and accelerating down with a = 5m/sec². Calculate the following. **(05)**

1. The gripping Force to retain the part.
2. Actuating force to achieve this gripping force.
3. Pressure of air needed to operate the piston.

1C. With PWM technique show how the position of DC servo motor can be controlled. **(02)**

2A. A hydraulic cylinder is used as the actuator of material handling robot . The pump delivers oil at the rate of 10L/min into the blank end of 75mm hydraulic cylinder as shown in fig 2. The piston contains 20mm dia cushion plunger which is 15 mm long, therefore the piston decelerates over the distance of 15mm towards the end of the extension stroke. The robot is required to push/pull a 150 kg load on the surface with co efficient of friction (μ)= 0.12.The maximum pressure(P1) at the blank end of the cylinder is to be restricted at 100N/mm². while the cushion is decelerating the piston **(04)**

Find the maximum pressure(P2) developed at the cushion.

2B. With the schematic show how the output signal is collected in a videcon camera. **(04)**

2C. A stepper motor actuates the arm of a Cartesian robot . For each pulse received from the driver circuit the motor makes a step angle of 18°.

a. What is the resolution of the stepper motor?
b. What is control resolution and accuracy of rotation?
c. How many pulses are required to rotate the motor through four complete revolutions?
d. If it is required to rotate the motor at a speed of 60 rpm what must be the pulse rate generated by the controller.

(02)

3A. For an object of I cross section show how edge detection and region growing technique and be used. **(04)**

3B. Write a VAL program for picking a job from the conveyor (fixed location) and place it on a machine A and after an elapsed time of 30 sec move the part to machine B. This sequence has to be repeated for 15 times **(04)**

3C. Enumerate some technical specifications of inductive and accelerometer sensors. **(02)**

4A. For SCARA show the Joint notation scheme and state degrees of freedom, link and joints robot. **(02)**

4B. Explain the variations of light intensity with the help of graph, for Incandescent bulb and fluorescent bulb as an interference light source. **(03)**

4C. Show how the speed of a robot actuator rated 300rpm can be reduced to 3 rpm using Harmonic drive. Discuss with the construction and formulae used. **(05)**

5A. A capacitive sensor with a sensing range of 10mm is used on a robot end effector to detect the presence of the object on a conveyor. There is blind range for the sensor; the object cannot be placed very close to the object. The sensor can only be placed to a distance of 4mm from the object. Based on the data given in the fig: 3 and fig: 4, prepare a list of materials from the available list that can be detected by the sensor. Justify your answer. **(04)**

5B. A stepper motor shaft is directly coupled to the material transport mobile robot with 4 wheels. The robot is required to be moved at a speed of 0.5m/ sec. The robot is required to maintain this constant speed even on the gradient of 20°. The maximum allowable weight on the robot is 30 kg including the self-weight of the robot. Calculate the torque required at the wheels to the drive the robot and the traction developed at the wheels. Assume the co efficient of friction between the wheel and the surface μ= 0.8. Wheel diameter =20 cm, coefficient of rolling resistance for the given wheel = 0.02 .Assume that robot is driven by two powered rear wheels. **(06)**

6A. Discuss different methods used for producing ultra-sonic signals in transducers. **(06)**

6B. Show with equations and circuit diagram how a LVDT and linear potentiometer can be used for positioning sensing in robots. **(04)**

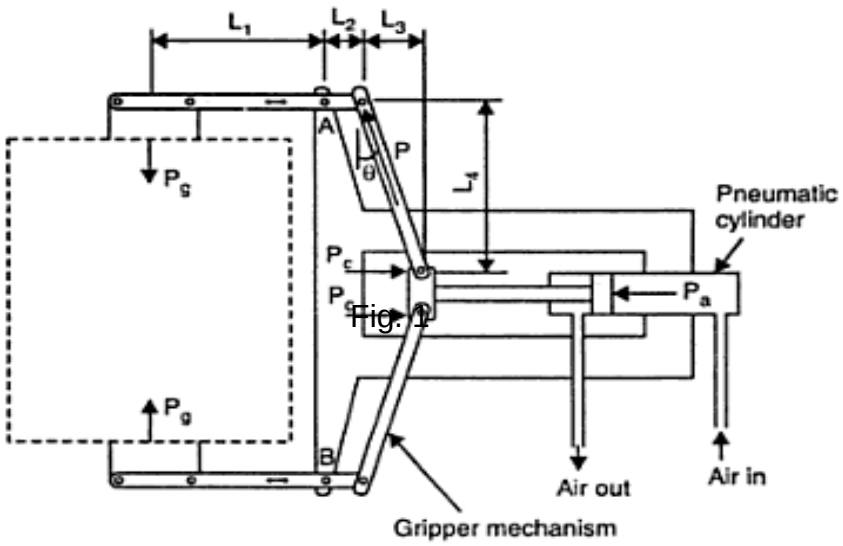

Fig. 1

Fig 1

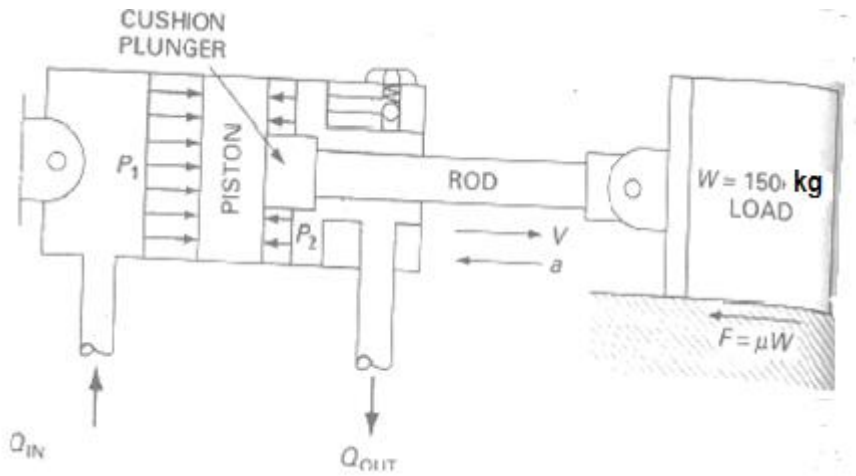

Fig 2

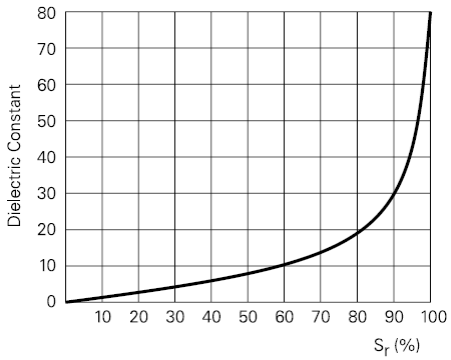

Fig: 3

Material	Dielectric Constant	Material	Dielectric Constant
Alcohol	25.8	Polyamide	5
Araldite	3.6	Polyethylene	2.3
Bakelite	3.6	Polyproplene	2.3
Glass	5	Polystyrene	3
Mica	6	Polyvinyl Chloride	2.9
Hard Rubber	4	Porcelain	4.4
Paper-Based Laminate	4.5	Pressboard	4
Wood	2.7	Silica Glass	3.7
Cable Casting Compound	2.5	Silica Sand	4.5
Air, Vacuum	1	Silicone Rubber	2.8
Marble	8	Teflon	2
Oil-Impregnated Paper	4	Turpentine Oil	2.2
Paper	2.3	Transformer Oil	2.2
Paraffin	2.2	Water	80
Petroleum	2.2	Soft Rubber	2.5
Plexiglas	3.2	Celluloid	3

Fig: 4