

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-3 EXAMINATION – DEC, 2021

B.Tech VII Semester

COURSE CODE: 20B1WEC731

MAX. MARKS: 35

COURSE NAME: AUTOMATION AND ROBOTICS

COURSE CREDITS: 3

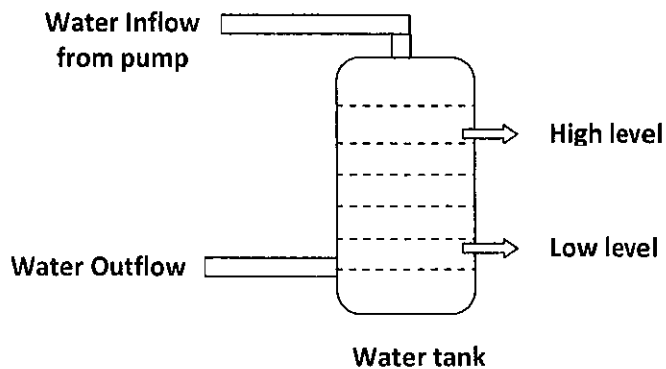
MAX. TIME: 2 Hours

---

*Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Missing data, if any, can be appropriately assumed.*

---

1. (a) What do you mean by automation? Briefly explain how automation systems were evolved over the past years. (2)  
(b) What are the different functional layers in industrial automation? Describe each one briefly. (3)
2. (a) Explain the working of Passive Infrared (PIR) Sensor. Give a situation where it can be used. (2)  
(b) Write short note on the following sensors used in automation and robotics: (3)  
(i) Accelerometer (ii) Gyroscope (iii) Optical Rotary Encoder.
3. (a) Describe the functions of remote terminal units (RTUs) and master station in SCADA hardware. (2)  
(b) Water is consumed randomly from a tank. The tank needs to be refilled by turning on a pump. Two hydrostatic switches are used to detect a high and low level in the water tank. Draw a Ladder Logic Diagram for PLC to control the pump for above system. (3)



4. Explain with a sketch, the following terms with respect to robot anatomy: (i) Link (ii) Joint (iii) Arm (iv) Wrist (v) End-Effector. (5)
5. The transfer function of Mass-spring-damper system is given by  $G(s) = 1/(100s^2+50s+1)$ . Write a program in Python to simulate the system. The program should plot the response of the system for a step input. (5)
6. Describe how the position and orientation of an End-Effector of a robot can be described using the entity frame. How can you describe a frame if you have the information of rotation matrix and position vector? (5)
7. Fig. shows a frame  $\{B\}$  which is rotated relative to frame  $\{A\}$  about  $\hat{Z}$  by  $30^\circ$ . (Here,  $\hat{Z}$  is pointing out of the image). If a position vector  ${}^B P$ , of frame  $\{B\}$  is given by  ${}^B P = [0, 2, 0]^T$ . (i) Find the rotation matrix,  ${}^A_B R$  of frame  $\{B\}$  with respect to frame  $\{A\}$ , (ii) Find the position vector  ${}^A P$  by mapping the vector  ${}^B P$  to frame  $\{A\}$ . (5)

