

**COLLEGE OF ENGINEERING, PUNE-5**  
(An Autonomous Institute of Govt. of Maharashtra)

**END Semester Exam**

**(IE 412) PROCESS MODELING AND OPTIMIZATION**

**Programme: Final B. Tech Instrumentation**

Year: 2011-12

Date: -12/05/2012

Duration: 3 hr

Max. Marks: 50

**Instructions:**

1. Figures to right indicate full marks.
2. Draw neat diagrams wherever required.
3. All questions are compulsory.

- Q.1 A** The data for decomposition of  $N_2O_2$  at  $65^\circ C$  is given. Find the order of the reaction. Calculate rate constant. **6**

Time/min.	0	1	2	3	4
$C_{N_2O_5}/\text{mole lit.}^{-1}$	0.16	0.113	0.08	0.056	0.040

- B** Define: **4**
- 1) Time value of money
  - 2) Daltons Law
  - 3) Profitability
  - 4) Equipment Cost

- Q.2 A** Maximize  $F = x_1 + 2x_2 + x_3$  **7**  
Subject to  
 $2x_1 + x_2 - x_3 \leq 2$   
 $-2x_1 + x_2 - 5x_3 \geq -6$   
 $4x_1 + x_2 + x_3 \leq 6$   
 $x_i \geq 0, i = 1,2,3$

- B** Discuss one application of least square method with suitable example. **3**

- Q.3 A** For finding optimum thickness of insulation formulate an objective function to maximize the saving in operating cost due to heat conserved less the annualized cost of the insulation also obtain an analytical solution for  $x^{opt}$ . **5**

- B** What are the important steps of Quadratic Programming Problem. **5**

- Q.4** **A** List the different methods of system identification. Explain any one with suitable example. **5**
- B** Explain Model reference adaptive control. Mention its applications **5**
- Q.5** **A** What are the design issues in fuzzy control? Also discuss Mamdani Architecture for Fuzzy control. **5**
- B** What are the main requirements of McCulloch-Pits neuron? Realize same model for OR gate. **5**

**\*All the Best\***

**College of Engineering, Pune**  
**Final Year – Instrumentation & Control**  
**IE 414-2 – Batch Process Control**

Academic Year: 2011- 12

Timing: 3 hrs  
Max. Marks: 50

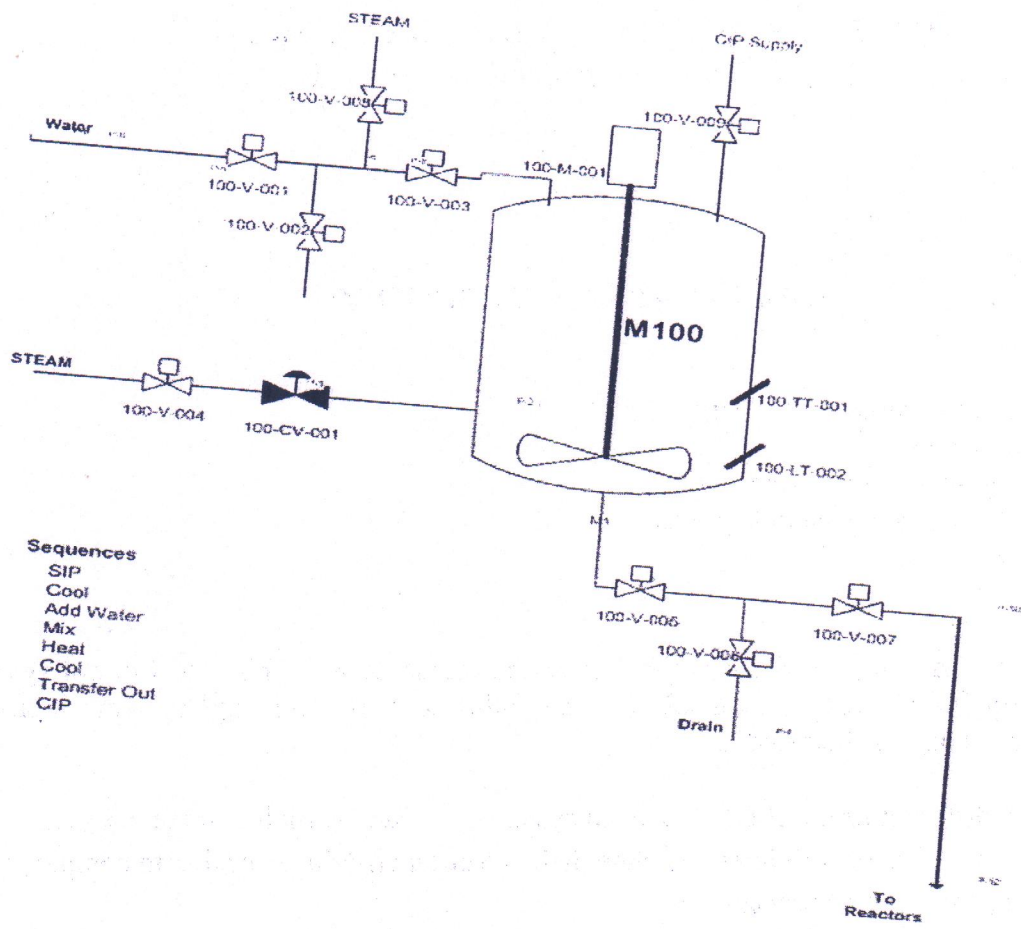
**End Semester Examination**

**Instructions:**

1. All Questions are compulsory & carry equal Marks
2. Assume suitable data
3. Draw neat diagrams wherever necessary
4. Use of non programmable calculators are allowed

- Q1 Considering a complex batch project, state the requirements for Batch Control system. How Top-Down design approach will be followed. List and explain typical project execution steps for the project.
- Q2 What are different types of Batch control system hardware available in the market? Explain those systems in brief and state their selection criteria according to complexity and size of the plant or process.
- Q3 Classify different types of recipes for batch processes. Discuss the detailing of the different types of recipes and the recipe structure.
- Q4 Explain detailed control activity model. Co-relate the same with batch physical model.
- Q5 Implement S88 physical model for the given P&ID in Fig 1.

Fig. 1



-----Best of Luck-----

Robotics ( Elective )

Programme : B.Tech. ( Instru. & Control )

Specialisation : Instrumentation & Control Engg.

Year : 2011 - 12

Date : 9<sup>th</sup> May 2012

Max. Marks : 50

Duration : 03 hr

- Instructions: -
- 1) Solve **Any Two** from Q. 1, 2, and 3.
  - 2) Solve **Any One** from Q.4 and Q. 5
  - 3) Figures to the right indicate full marks
  - 4) Draw neat figures wherever required

Q.1 a) Discuss 'Accuracy, Precision and Repeatability' required for the Robots Performance analysis. Explain with the help of required sketches various types of Precision. Mention their peculiar features to understand its utility for highly precise robotic operation. [ 08 ]

OR

a) Determine the worst spatial resolution of a spherical robot having a 800 mm arm length. The robot is equipped with an encoder emitting 1500 pulses per revolution. The linear axis is actuated with lead screw of 25 mm pitch, & encoder is mounted on the lead screw. [ 08 ]

b) What do you mean by the term "Compliance" ? How it is concerned with the robotics as a remedy to rigid end effectors problems? Explain RCC device with neat sketch. [ 07 ]

Q.2 a) An Industrial Robot is to be designed for its stepper motor to drive a prismatic joint. The Stepper Motor shaft is connected to a screw shaft with a pitch of 3 mm. The control resolution of 0.5 mm is desired from the controller. Determine

- i) The number of step angles on the motor to achieve this control resolution.
- ii) The pulse rate, required to drive the joint with a linear speed of 150 mm/sec. [ 08 ]

OR

a) Explain principle of working of on **any two** of the following electric motor with the help of suitable diagram. Give its advantages & disadvantages in relevance with its use for robot industries.

- |                      |   |
|----------------------|---|
| i) A.C. Servo motors | ii) Induction Motors                    |
| iii) Stepper motors  | iv) Disk or shell type of D. C. motors: |
- [ 08 ]

b) State various basic control actions observed while obtaining the desired movements of actuators. Discuss in detail with circuit diagram, the most commonly used controller action for efficient control of an industrial robot. [ 07 ]

laborate the use of vacuum cups as a robotic gripper in the industries. Calculate the size of the vacuum cup which is to be used to lift the 4.75 N of steel plate having an area of 350 X 350 mm. Using a factor of safety 2 suggest proper cup size if two such type of grippers are to be employed to lift the plate by creating 18.5 KPa vacuum pressure (with reference to atmospheric pressure ).

[ 08 ]

OR

- a) Explain Lead Through Programming Method, used at manual mode and automatic mode for robots. Also discuss the limitations of this type of programming method in detail. [ 08 ]
- b) Give the available known list of Robot Languages and discuss the robot programming languages used for the robots and its development from WAVE language till to date. [ 07 ]

Q.4 a) Robot system of five joints, is being used for handling the job / work piece against the gravity. The link parameter table of the arm is given as below.

Link	$\alpha_{i-1}$	$a_{i-1}$	$d_i$	$\theta_i$
1	$45^\circ$	0	$d_1$	0
2	0	0	25	0
3	0	50	0	$90^\circ$
4	$90^\circ$	0	10	0
5	0	60	$d_2$	$60^\circ$

Determine the corresponding joint variables  $d_1$  and  $d_2$  using Forward Kinematics Method if the end position of the gripper is [ 2 , 10 , 8 ] w.r.t. home position [ 0, 0, 0]. [ 12 ]

- b) Write a detail note on **any two** of the following terms [ 08 ]
  - i) Use of Lagrangian Analysis for a robot manipulator arm
  - ii) Inverse Kinematics and its application
  - iii) D-H representation for kinematic analysis of manipulator arm

Q.5 Write a short note with elaborations, examples and the figures ( if any ). ( **any four** ) [ 20 ]

- i) Details of SCARA and PUMA robot with necessary neat sketches.
- ii) Types of Non Optical Position Sensors.
- iii) Convolution Masking and Thresholding Process to get binary image.
- iv) A.I. for Robotics and Techniques of A.I.
- v) Noise Reduction Techniques in Image Processing.
- vi) Steps of D-H principles to obtain the Joint Parameters of robot.
- vii) Homogeneous Transformation Matrix for Robotics - Definition and Derivation.

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