COLLEGE OF ENGINEERING PUNE

(An Autonomous Institute of Government of Maharashtra)

End Semester Examination

(IE 304) Analytical Instrumentation

Programme: T. Y. B. Tech (Instrumentation and Control)

Year: 2011-12 Semester: I

Duration: 03 hrs Max. Marks: 50

Instructions:

1. All questions are compulsory.
2. Figures to right indicate full marks.
3. Draw neat figures wherever required.
4. Use of non-programmable calculator is allowed.
5. Assume suitable data if required.

Q.1 (a) Explain the sources of errors in spectrophotometric measurements. 02

(b) State and justify an appropriate ionization technique of mass spectrometer for analyzing gasoline fractions. 02

(c) List down the significant characteristics of HPLC technique. 02

(d) Name any four detectors for X-ray spectroscopy. 02

(e) Suggest any two suitable techniques for determining quantitative relationship between suspended particle size and light scattering. 02

Q.2 (a) Explain in detail the type of mass analyser, which does not require a magnetic field for its operation. 04

(b) Discuss any two types of pH meter. 02

(c) It is required to measure CO, CO_2, SO2, Nitric oxide and hydrocarbons by infrared analyzers. Explain its working principle with its block diagram. 04

Q.3 (a) Explain the working of following GC detectors with its block diagram, advantages, limitations and applications for the following:

i. Thermal Conductivity (TCD)

ii. Flame Ionization (FID) 08

(b) What is the working principle of optical densitometer? 02

Q.4 (a) It is required to identify crystalline phases in the material. Suggest and explain the suitable technique. 04

(b) Explain any two types of HPLC detectors. 04

(c) List down any four interferences for AAS. 02

Q.5 (a) Name an appropriate analytical technique for the following applications:

1. Analysis of polymers up to 50,000 dalton
2. Measurement of sodium concentration in a sample
3. Quantitative analysis of Copper in fish sample
4. functional group of molecule 02

(b) Explain the following terms used in analytical instruments:

1. Chemical Ionization
2. Grating monochromator
3. Nebulisation
4. Interferogram 04

(c) Explain the instrumentation for IR spectroscopy 04

OR

Explain the instrumentation for Atomic Absorption Spectroscopy 04

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College of Engineering, Pune
Third Year B. Tech. – Instrumentation & Control
SUB: Control System Components (IE-302)
END Semester

Date-22 /11/2011
Academic Year: 2011- 12

Timing: 3 hrs
Max. Marks: 50

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

Q. 1	A.	Explain working principle of DC motor. Write equation for torque and speed of DC motor.	Marks 5
	B.	What are different speed control methods of Induction motor. Explain with help of equation and torque-speed curve.	5
Q. 2	A.	Describe operation of a latching relay that uses two coils.	4
	B.	List down soft starting methods used to start AC motors. Explain operation of any one method with neat diagram.	6
Q. 3	A.	Write the importance of components used in motor control circuit. Draw and describe wiring diagram for DOL starter.	5
	B.	What do you mean by "Jogging" operation of motor. Design a jog control circuit and explain sequence of operation of the same.	5
Q. 4	A	Draw and explain working of pneumatic "Time delay valve".	4
Q. 4	B.	List down components required to build pneumatic circuit for following application and build pneumatic circuit: A cylinder advances a forming tool on an edge folding device. If the sheet is detected to be present and if the push button is pressed then cylinder is to advance for rapid forward travel. If push button is released, the double acting cylinder is to return slowly to the initial position.	6

Q. 5	A.	Draw 4/2 direction control spool valve, manually actuated spring return hydraulic valve with symbol. Write working principle of the same.	5
Q. 5	B.	Draw regenerative hydraulic circuit. Justify 'Regenerative circuits are used to obtain equal speeds in both directions in a DA cylinder.'	5

COLLEGE OF ENGINEERING, PUNE

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END SEMESTER EXAMINATION

(IE 305) Control System Design

Programme: T.Y.B.Tech. (Instrumentation & Control) Year: 2011-12
Duration: 3 Hours Max. Mark: 50

Instructions to candidates:

1. All questions are compulsory.
2. Neat diagrams must be drawn wherever necessary.
3. Figure to the right indicate full marks.

Q. 1 (a) For a given system **(4)**

$$\dot{x}(t) = \begin{bmatrix} -4 & 3 \\ -6 & 5 \end{bmatrix} x(t)$$

Determine eigen values and eigen vectors of a matrix A, and use these results to find state transition matrix.

(b) Design an observer for a plant **(6)**

$$G(s) = \frac{10}{(s+1)(s+4)(s+8)}$$

operating with 5% overshoot and 1 sec peak time. Design the observer to respond 10 times faster than the plant. Place the observer third pole 20 times farther from imaginary axis than the observer dominant poles. Assume the plant is represented in observer canonical form.

Q. 2 (a) Construct state models for following differential equation. Obtain a controllable canonical form (with hardware realization) for the system **(4)**

$$\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = \dddot{u} + 12\ddot{u} + 11\dot{u} + 6$$

(b) Consider the following TF **(6)**

$$G(s) = \frac{(s+6)}{(s+10)(s+3)(s+8)}$$

if the system represented in cascade form in a way $\frac{1}{(s+3)}, \frac{(s+6)}{(s+3)}, \frac{1}{(s+8)}$, design a controller to yield a closed loop response of 10% overshoot with settling time of 1 sec. Design the controller by first transforming plant to phase variable form.

Q. 3 (a) Derive mathematical model for heat exchanger by considering ambient temperature changes affects the system performance. **(5)**

(b) Discuss system delay and way of handling it. **(5)**

Q. 4 (a) For a unity feedback system with OLTF as **(5)**

$$G(s) = \frac{K}{(s+1)(s+4)}$$

design PID controller that will yield a peak time of 1.047 sec and damping ratio of 0.8, with zero error for step input. Use root locus approach.

(b) For a unity feedback system with OLTF as **(5)**

$$G(s) = \frac{K}{s(s+10)(s+30)}$$

design compensator to decrease settling time by factor of 3 without affecting a peak overshoot which is 15%. Use root locus approach.

Q. 5 (a) For a unity feedback system with OLTF as **(6)**

$$G(s) = \frac{10K}{s(s+1)}$$

design compensator such that the closed loop system will satisfy the following requirement:
static velocity error constant=20
phase margin=50
Gain Margin $\geq$ 10

(b) Determine the controllability and observability of the following **(4)**

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}, B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}, C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

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Q. 4	A	Draw and explain working of pneumatic "Time delay valve".	4
Q. 4	B.	List down components required to build pneumatic circuit for following application and build pneumatic circuit: A transfer station removes a product from a conveyor belt. If the product is detected as present and if the operator presses the pushbutton, the pick-up cylinder extends. Upon release of the pushbutton the cylinder is to retract to the initial position.	6
Q. 5	A.	Draw 4/2 direction control spool valve, manually actuated spring return	5

		hydraulic valve with symbol. Write working principle of the same.	
Q. 5	B.	Draw regenerative hydraulic circuit. Justify 'Regenerative circuits are used to obtain equal speeds in both directions in a DA cylinder.'	5