COLLEGE OF ENGINEERING, PUNE-5

(An Autonomous Institute of Govt. of Maharashtra)

MID SEMESTER EXAMINATION

(PI 511) TRANSDUCER DESIGN

Programme: F. Y. M.Tech.
(INSTRUMENTATION AND CONTROL-BIOMEDICAL INSTRUMENTATION)
Year: 2011-12 Semester I
Duration: 3 hrs Max. Marks: 50

Instructions:

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

Q.1 Design a Hall Effect based sensory system used in Blood Processing Unit (BPU). Your design should cover all design aspects of sensors like sensivity, signal conditioning, constraints on usage, environment, and output etc. Indicate clearly the limitations of this sensory system over other systems currently used in the BPU. What are various parameters which will degrade performance of this system and suggest methods to tackle them in brief. **(15)**

Q.2 Using Virtual Laboratory design framework, design minimum three sensors mentioned in your individual sheet of evaluation which will improve the existing Static and Dynamic characteristics (Wherever Applicable) of the sensors by 3 %. You are required to suggest three methods for the improvement of the framework so as to improve overall design experience by way of better user interface. The results of your findings are to be saved on the portal along with your username as indicated previously. The sketches and rough work during the design process needs to be written in answer sheet which will be part of evaluation. Evaluate the effect of at least three parameters which will deteriorate the performance of the sensor. Comment on the methods used and additional resource requirement for compensating such parameters. **(35)**

College of Engineering, Pune

END SEMESTER EXAM (2011-12)

BI533 - (Physiological Modeling)

Year: First Year M. Tech
Max. Marks-50
Date:- 21/11/2011

Branch: Biomedical Instrumentation
Duration – 3 hr
Time:- 4pm to 7pm

Instructions:
1. All questions are compulsory
2. Number given at right indicates marks.
3. Use of programmable calculator is not allowed.

Q. 1 A What are the different types of eye movements? Model the saccadic eye movement. 8

B How human immune system works? Model Hepatitis B Viral infection with respect to human immune system. 7

Q. 2 A A cell is required to secrete enzymes (proteins) to breakdown food material. Design a simple gene network model to control/regulate transcription. 15

Q. 3 Solve any four 20

A What is minimum spanning tree? Explain Prim's algorithm with example.

B State and define following basic bio-physics tools. A) Fick's law for diffusion of charged particles b) Ohm's law for drift of charged particles c) Einstein's relationship d) space charge neutrality

C What are the different types of sampling? What is stratified sampling? Explain with example.

D What is Gait cycle? Explain with different phases.

E Explain the different steps in simulation study.

F Explain single compartment cell model for enzyme mediated catalytic reaction.

IDE

November 2011

College of Engineering, Pune

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End Semester Examination

Instrument Design Engineering

Semester I

Academic Year: 2011-12 **Branch: Instrumentation & Control**

Class: First Year M. Tech **Duration: 3 hours**

Max. Marks: 75

Instructions:

1. **All questions are compulsory.**
2. **Draw neat figures wherever required.**
3. **Assume suitable data if necessary.**

Section – I

Answer all questions. Each question carries 1 mark.

Q.1 The purpose of balancing is to make the noise pickup equal in both the conductors. Balancing in many cases is a cost effective noise reduction technique. Answer the following.

a. In a balanced system , both resistive and reactive balance must be maintained.(T/F)
b. When source impedance is low and load impedance is high multi-element filter must be used to improve filtering. (T/F)
c. To minimize noise, the bandwidth of a system should be no more than that necessary to transmit the desired signal.(T/F)
d. The higher the characteristics impedance of a dc power distribution circuit, the less the noise coupling over it.(T/F)
e. From noise point of view dissipative filter is preferred over a reactive filter.(T/F)

1a	1b	1c	1d	1e

Q. 2 Electromagnetic interference (EMI) is a major problem for circuit designers and people who deploy and use sensitive electrical equipment. Choose the right option, True (T) or False (F) for the cases as below:

a. In case of emission problem we should most likely attack source of the emission by changing its characteristics (T / F)
b. As per FCC regulations, Emission limits for Class B devices (used in residential environment) are about 10 dB more restrictive than those for Class A (used in commercial, industrial or business environment)
c. Designing equipment that does not generate noise is as important as designing equipment that is immune to noise (T / F)
d. A wire running through a noisy environment may pick up noise and then conduct noise into another circuit. There it causes interference. The solution is to prevent the wire from picking up the noise and/or to remove the noise from it by filtering before it interfaces with the susceptible circuit. (T/F)
e. When the receiver is close to the source, radiation is considered as combined Electric and Magnetic or Electromagnetic radiation. (T/F)

2a	2b	2c	2d	2e

Q. 3 Cables are important because they are usually the longest parts of a system and therefore act as efficient antennas that pick up and /or radiate noise; state True (T) or False (F) for the statements below:

a. Electric field coupling can be modeled by inserting a noise voltage generator in series with the receptor (T/F)
b. Electric fields are much easier to guard than magnetic fields. (T/F)
c. The key to reducing magnetic coupling is to decrease the area of the pickup loop. (T/F)
d. To prevent magnetic field radiation or pickup, a shield grounded at both the ends is useful above audio frequency (T/F)
e. At high frequencies cable shields should be grounded at both the ends. (T/F)

3a	3b	3c	3d	3e

Q. 4 Process Industry present harsh noisy electrical environment whereas signals may have to be transmitted over long distances. Identify statements from below as True or False:

a. Current transmitters are preferred as they provide better noise immunity (T/F)
b. In Industrial environment always current transmitters are preferred over voltage transmitter as they are less sensitive to long cable lengths (T/F)
c. Current transmitters can provide ground isolation between control room and field mounted devices. (T /F)
d. Twisted shielded pair with shield not grounded at either end will provide best noise immunity (T /F)
e. Current transmitters provide advantage as multiple unlimited number of transmitters can be powered from a single power source (T /F)

4a	4b	4c	4d	4e

Q 5 Choice and use of suitable cable and connecter is critical to satisfactory operation of equipment. Identify statements from below as True or False:

a. Coaxial cables are preferred to twisted pair cable when the operational frequency exceeds 10 Mhz (T /F)
b. An unshielded twisted pair, unless its terminations are balanced, provides very little protection against electric field pickup, but provides very good protection against magnetic pickup. (T /F)
c. A proper shield termination requires 360 deg contact with the shield (T /F)
d. For satisfactory operation of twisted shielded cable, pitch of the twist has to be greater than one twentieth of a wavelength at the frequencies of concern (T /F)
e. For a spiral shield cable, the shielding effectiveness begins to decrease above about 100 kHz and for a braided shield cable the shielding effectiveness begins to decrease above about 10 MHz (T /F)

5a	5b	5c	5d	5e

Section II

Q. 6		
a.	What are the three important characteristics of noise?	2
b.	Two conductors, each 10 cm long and space 1cm apart, from the circuit. This circuit is located where 10gauus magnetic field at 60Hz. What is the maximum noise voltage coupled into the circuit from the magnetic fields?	3
Q. 7		
a.	Explain effect of shield on magnetic coupling	2
b.	List three regions that common mode filters are harder to design than differential mode filter?	3
Q.8	What do you mean by shielding? Briefly explain how shielding is depend on absorption loss and reflection loss	5
Q. 9	Calculate the shielding effectiveness of 0.015 inch thick copper shield located 1 inch from source of 10 KHz magnetic field What would be the shielding effectiveness of the shield for the above problem if it were located in the far field?	5
Q. 10	Which are the two types of breakdown are important in switching contacts? Explain it with their characteristics.	5
Q. 11	Briefly explain differential mode and common mode radiation in case of digital circuit and explain how to minimize the same.	5
Q. 12		
a.	Draw human body model and explain how humans are prime source of electrostatic discharge	2
b.	Calculate the noise voltage produced by a 5000 ohm resistor in a system with 100khz bandwidth at temperature of 27^0 C and 100^0 C	3
Q. 13	List different intrinsic noise sources and explain them briefly.	5
Q. 14		
a.	Why ESD protection should be the part of the design and not added at the end? What are different approaches for effective ESD immunity? Explain briefly.	5
Q. 15		
a	Compare noise and interference. Why you must consider electromagnetic compatibility of an instrument during the design and not at the end? Explain it with the cost to solve the noise/EMC problem and equipment development time scale.	5

COLLEGE OF ENGINEERING, PUNE

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END SEMESTER EXAMINATION

(IE) Modern Control Theory

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

Instructions to candidates:

1. All questions are compulsory.
2. Figure to the right indicate full marks.

Q. 1 (a) A sampled data unity feedback system whose TF is **(4)**

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

The sampling period is $T = 1$ sec. Sketch the bode plot for the system.

(b) Find state transition matrix **(6)**

$$\dot{x}(t) = \begin{bmatrix} 0 & 20 \\ -2 & -4 \end{bmatrix} x(t)$$

by

i. Similarity transformation
ii. Laplace inverse transformation
iii. Calay-Hamilton method

Q. 2 (a) Consider a system with unit feedback whose OLTF is given by **(6)**

$$G(s) = \frac{1}{(s+2)(s+1)}$$

The sampling period is $T = 1$ sec. Design compensator that meets $\zeta = 0.5$, $\omega_n = 1.5, K_p = 7.5$

(b) Construct state models for the following TF. Obtain a controllable canonical form (with hardware realization) for the system **(4)**

$$G(s) = \frac{10(1 + s/4)}{(s/6+1)(s/7+1)}$$

Q. 3 (a) For a given system **(4)**

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \end{bmatrix} x(t)$$

(b) Design a controller for the plant **(6)**

$$G(s) = \frac{20(s+2)}{s(s+4)(s+6)}$$

operating with 10% overshoot and 0.5 sec peak time. Place the third pole 10 times farther from imaginary axis than the observer dominant poles. Use phase variable form.

Q. 4 (a) Design an observer for a plant **(5)**

$$G(s) = \frac{50}{(s+3)(s+6)(s+9)}$$

operating with 10% overshoot and 0.5 sec settling time. Design the observer to respond 10 times faster than the plant. Place the observer third pole 10 times farther from imaginary axis than the observer dominant poles. Assume the plant is represented in observer canonical form.

(b) Consider the following TF **(5)**

$$G(s) = \frac{K}{s(s+5)(s+20)}$$

The uncompensated system has about 55% overshoot and peak time of 0.5 sec $K_v = 10$. use frequency response mehod to design lead compensator to reduce the percent overshoot to 10% while keeping peak time steady state error same.

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

$$G_{h0}G(z) = \frac{0.2385(z+0.8760)}{(z-1)(z-0.2644)}$$

The sampling period $T = 0.2$ sec. Determine steady state errors for step input, unit-ramp and unit-acceleration inputs.

(b) For unity feedback control system having following OLTF **(6)**

$$G(s) = \frac{K(s+1)}{s(s+2)(s+3)(s+4)}$$

Draw root locus and find the value of gain that will make system marginally stable.

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Department of Instrumentation and Control

Academic Year: Autumn 2011 — **PI 531:** Process Systems Engineering

End Semester Examination — Duration: 3 Hrs — Maximum Marks: 50

- Read through all problems before starting.
- All questions are compulsory.
- Assume suitable data, if necessary.
- All symbols have their usual meaning.
- Use of Calculator is allowed.

Q1. Plant Analysis [15]

Derive the state space model for a continuously stirred tank reactor where a liquid phase reaction $A + B \longrightarrow C$ is carried out.

Q2. Control Strategy [10]

Describe at least three different control strategies for the CSTR in above example using P&I diagram. Which of these control strategies is the best for temperature control? What are the benefits of effective control strategy on key performance indicators?

Q3. Linear Optimal Control [10]

1. Derive LQR control policy for a continuous-time infinite horizon linear time invariant state space system using following performance criterion.

$$
\begin{aligned}
J &= \min_{u(.)} \int_0^\infty \left(x^T Q x + u^T R u \right) dt \\
\frac{dx}{dt} &= Ax(t) + Bu(t); \;\; x(0) = x_0 \\
u &= Kx + L
\end{aligned}
$$

Q4. Numerical Analysis [15]

1. Transfer function for a process plant is given as, $G_p = \frac{1}{10s+1} e^{-5s}$. Using second order Padé approximation, find the value of open loop steady state process gain.
2. What is the offset for proportional only control with proportional gain of 2?
3. What is the gain value of linear optimal controller using control policy of Q3?

COLLEGE OF ENGINEERING, PUNE

DEPARTMENT OF MATHEMATICS

END SEMESTER EXAMINATION

IE – 501-9 - Advanced Mathematics

F.Y.M.Tech (INSTRU & MECH) Date:19/11/2011

Max. Marks: 50 Time: 3Hrs.

N.B. 1) All questions are compulsory.

2) Answer TWO SUBQUESTIONS from each questions.

3) Figures to the right indicate marks.

4) Draw neat and clean diagrams whenever required.

5) Use of non programmable calculators is allowed.

Q.1) (A) For a sampling plan N = 1200, n = 64 and c =1 determine the probability of acceptance of the following lots and also draw an operative characteristic curve. 05

a) 0.5% defective b) 0.8% defective c) 1% defective d) 2% defective e) 4% defective f) 10% defective.

(B) State any Five advantages of ISO : 9000 series 05

(C) Construct Mean and R – chart for the following data: 05

Samples	1	2	3	4	5	6	7	8
Obs. I	32	28	39	50	42	50	44	22
Obs. II	37	32	52	42	45	29	52	35
Obs.III	42	40	28	31	34	21	35	44

Given that for n=3, $A_3 = 1.023$, $D_3 = 0$, $D_4 = 2.575$

Q.2) (A) Solve the differential equation $\frac{dy}{dx} = 3x^2 + 1$ with $y(1) = 2$. Estimate $y(2)$ by Euler's method using (i) h = 0.5 (ii) h = 0.25. 05

(B) Evaluate the pivotal values of the equation $u_{tt} = 16u_{xx}$ taking $\Delta_x = 1$ upto $t = 1.25$. Taking boundary conditions are $u(0,t) = u(5,t) = 0, u_t(x,0) = 0$ and $u(x,0) = x^2(5-x)$ 05

(C) Define the following 05

1. Hyper plane 2. Convex set 3. Feasible solution 4.Basic solution 5.optimal solution

Q.3) (A) Explain the areas of application of Linear programming in brief. 05

(B) A plant manufactures washing machines and dryers. The manufacturing departments are the stamping department, motor and transmission department and assembly department. The first two departments produce parts for both the products while the assembly lines are different for the two products. The monthly department capacities are 05

Stamping Deptt. : 1000 washers or 1000 dryers.

Motor & Transmission Deptt. : 1600 washers or 7000 dryers.

Washers assembly line : 9000 washers only.

Dryers Assembly line : 5000 dryers only.

Profits per piece of washers and dryers are Rs. 270 and Rs. 300 respectively. Formulate the L.P. model.

(C) A firm manufactures two items. It purchases casting which are then machined, bored & polished. Casting for items A and B cost Rs. 2 and Rs. 3 respectively, and are sold at Rs. 5 & Rs. 6 respectively. Running cost of the 3 machines as Rs. 20, Rs. 14 and Rs. 17.50 per hour respectively. 05

Capacities of machine are	PART A	PART B
Machine capacity	25/hr	40/hr
Boring capacity	28/hr	35/hr
Polishing capacity	35/hr	25/hr

Formulate L.P. mode to determine the product mix that maximizes the profit.

Q.4) (A) Solve the following L.P. problem by Graphical Method 05

Max. $Z = 3x_1 + 4x_2$: Subject to Constraints: $5x_1 + 4x_2 \leq 200$

$3x_1 + 5x_2 \leq 150$

$5x_1 + 4x_2 \geq 100$

$8x_1 + 4x_2 \geq 80$ $\quad x_1, x_2 \geq 0$

(B) Solve the following L.P. problem by Simplex Method 05

Max. $Z = 2x_1 + x_2$

Subject to Constraints: $4x_1 + 3x_2 \leq 12$

$$4x_1 + x_2 \leq 8$$

$$4x_1 - x_2 \leq 8 \qquad x_1, x_2 \geq 0$$

(C) Write a Dual problem corresponding to 05

Max $z = 5x_1 + 8x_2 + 10x_3$

Subject to constraints $x_1 + x_2 + 2x_3 \leq 120$

$$3x_1 - 2x_2 - x_3 \geq 90$$

$$2x_1 + 4x_2 + 2x_3 = 100 \qquad x_1, x_2, x_3 \geq 0$$

Q.5) (A) A manufacturer manufactures a 200 light blub and put them on a test with a specified time interval of time and observes the failures of blub during a testing which is given in the following table. 05

Time(hrs)	0-1000	1001-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000
Failure	100	40	20	15	10	8	7

Calculate failure density function [F(t)] and Reliability Function [R(t)] for each interval.

(B) A first generation computer contains 10000 components each with failure rate 0.5% per 1000 hrs. What will be period of 99% reliability. 05

(C) Write a short note on repair vs. replacement 05

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END SEMESTER EXAMINATION

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