302050

Seat No.	

T.E. (Mechanical) (Semester – II) Examination, 2014
MECHATRONICS
(2008 Course)

Time : 3 Hours Max. Marks : 100

Instructions : *1) Answer **three** questions from Section **I** and **three** questions from Section **II**.*
*2) Solve Q. **1** or **2**, Q. **3** or **4**, Q. **5** or **6**, Q. **7** or **8**, Q. **9** or **10**, Q. **11** or **12**.*
*3) **Draw** diagrams **wherever** necessary.*
*4) **Use** of scientific calculator is **allowed**.*
*5) Assume **suitable** data wherever **necessary**.*

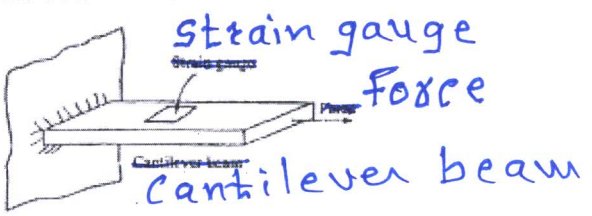
SECTION – I

1. a) Explain the functional elements of a measurement system. **8**
   b) What are the basic temperature-measurement principles and main differences between the following temperature sensors : (1) RTD, (2) thermistor, and thermocouple ? **8**

OR

2. a) Explain the terms (a) precision and accuracy and (b) Hysteresis and repeatability when applied to a measurement system. **8**
   b) What type of temperature sensor would you recommend for the following cases and why ? (1) Temperature measurement of a small volume electronic part with highly transient temperature condition. (2) Temperature measurement of a liquid in a large container. **8**

3. a) Consider the stress and force measurement on a rectangular beam. Assume that a horizontal force is applied at the tip of the beam, and the other end is clamped to a stationary base (Figure). A strain gauge is bonded on the surface at the midpoint along the length of the beam in the direction of the deformation. **10**



   1) Draw step by step procedure to integrate the strain gauge to signal conditioner (i.e. Wheatstone bridge circuit)
   2) What other information is needed in order to measure the strain, stress, and external force applied on the beam ?

   b) Why Temperature compensation is important in case of strain measurement and how it is achieved ? **6**

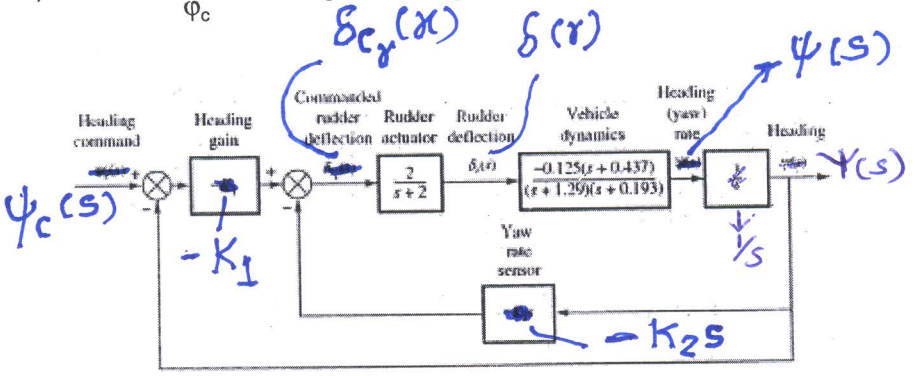
OR

4. a) Compare an LVDT with a potentiometer as a position sensor. How direction of motion is sensed using LVDT ? Explain with appropriate figure. **6**

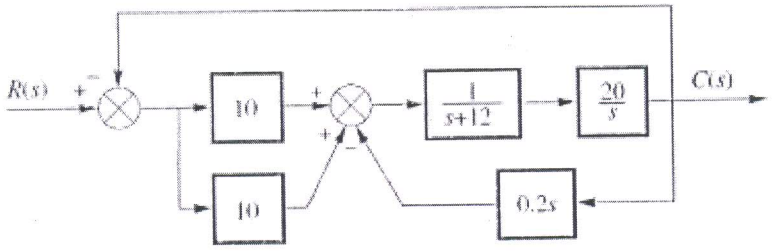
   b) Consider a strain gauge with nominal resistance of $120\,\Omega$. It is glued on the surface of a structure. The structure deforms nominally 0.001 strain level $\left(\varepsilon = \frac{\Delta l}{l} = 0.001\right)$. Assume that the gauge factor of the strain gauge is 2.0. Determine the change in the nominal resistance of the strain gauge under this condition. **10**

5. a) In case of laser scanning machine, laser spot position is measured using LVDT which is mounted on positioning stage. And further processed using DAQ system having a maximum sampling frequency of 500 KCycles/s. Determine the possible maximum scanning speed using proposed system. **6**

   b) 1) Estimate $\frac{\varphi}{\varphi_c} = ?$ using block diagram reduction method. **6**



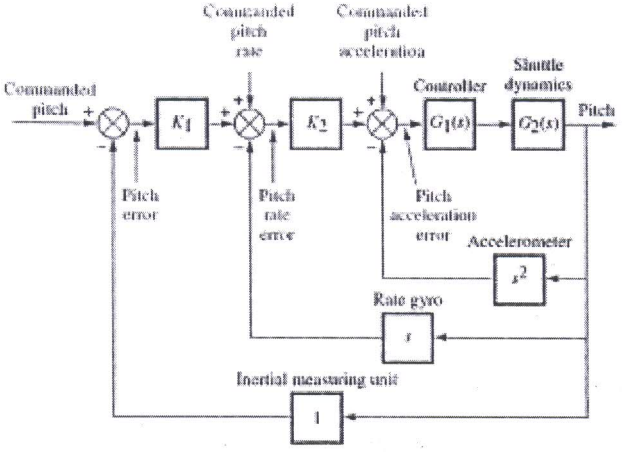
   2) Estimate $G(s) = \frac{C(s)}{R(s)}$ using block diagram reduction method. **6**



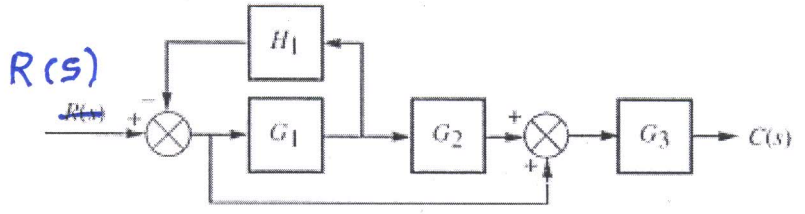
OR

6. a) Temperature values from – 20°F to 120°F are input data for a microprocessor computer. Are 8 bits sufficient measure the minimum temperature change of less that 0.5°F ? If so, what is the resolution ? 6

b) 1) Estimate transfer function $G(s) = \frac{\text{Pitch}}{\text{Commanded Pitch}}$. 6



2) Estimate a transfer function $G(s) = \frac{C(s)}{R(s)}$. 6



SECTION – II

7. a) a. Give an practical examples for following type of control systems 6
b. Feedback control system
c. Regulator control system

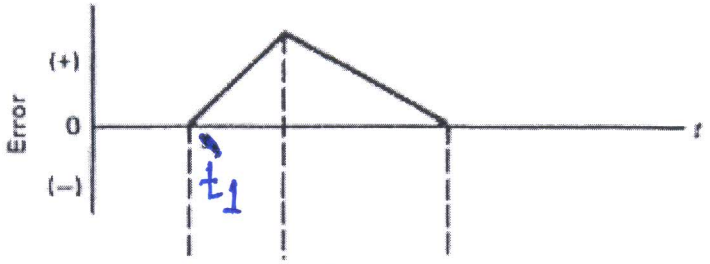
b) The controlled variable in a closed-loop system is a robot arm. Initially, it is at 45°; then it is commanded to go to 30°. Describe what happens in terms of set point, feedback signal, error signal, and arm position. 10

OR

8. a) a. Draw a block diagram of a closed-loop control system. 6
b. Use the block diagram to describe how the system works.

b) A motor was measured to rotate (unloaded) at 500 rpm with a 6-V input and 1000 rpm with a 12-V input. What is the transfer function (steady state) for the unloaded motor ? 10

9. a) Draw a controller output for following error variation, draw proportional, integral control and Proportional + Integral control actions **10**



b) Select the control system (Proportional + Integral, and Proportional + Derivative and Proportional + Integral + Derivative Control Actions) **6**

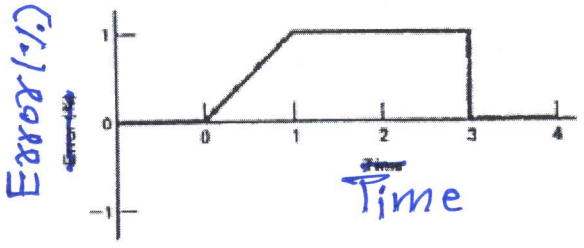
1) Scanning System with large Friction during motion.

2) Scanning system with zero friction and backlash and noise in position measurement.

Explain your selection with appropriate reasoning.

OR

10. a) Draw a controller output for Proportional Controller and Proportional + Integral control actions and Proportional + Integral + Derivative Control actions for following error pattern. **10**



b) Explain working of PID control actions and why these control actions are mostly used in industry. **6**

11. a) Explain application of PLC system for following case studies. **6**

1) Bottle Filling Machine

2) Elevator

b) A small house has three windows and two doors. Each window and door has a switch attached such that the contacts close when a door or window opens. Draw a ladder logic diagram that will turn on a light if one or more windows are open or if both doors are open. **12**

OR

12. a) A process for washing parts requires the following sequence : **12**

1) Spray water and detergent for 2 min *(Wash cycle)*

2) Rinse with water spray till cloths get completed clean (sensed by sensor) *(Rinse cycle)*

3) Water off, air blow dry for 3 min *(Drying cycle)*.

The sequence is started with a toggle switch. Draw the ladder diagram for this process (using the Sequencer instruction).

b) Explain basic elements of PLC systems and its applications. **6**