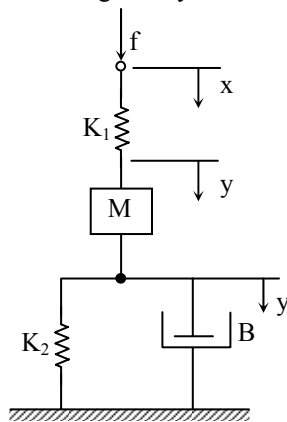


- N.B. :**
- (1) Question No. 1 is compulsory.
  - (2) Answer any **four** questions out of remaining **six** questions.
  - (3) Assumptions made should be clearly stated.
  - (4) Assume any suitable data wherever **required** but justify the same.
  - (5) Figures to the right indicate full marks.
  - (6) Illustrate answers with **sketches** wherever **required**.
  - (7) Answer to question should be **grouped** and written together i.e. **all** answers to sub questions of individual questions like questions No. **1, 2, 3** etc. should be answered **one below the other**.
  - (8) Use **legible** handwriting. Use a **blue/black ink pen** to write answers. Use of **pencil** should be done only to **draw diagrams** and **graph**.

1. (a) What are advantages of mechatronics design over electromechanical : design ? [4]  
 (b) What are the conditions for connecting mass in mechanical system? What is “grounded – chair” representation of mass ? [3]  
 (c) Explain basic principle of range sensors. [3]  
 (d) What are the applications of microsensors ? [3]  
 (e) Explain basic principle of fluid cylinders. [3]  
 (f) Explain process log, control log, dead time and delays due to cycling in process control. [4]
2. (a) Explain Key elements of mechatronics. [4]  
 (b) Explain concurrency of mechatronics design. [4]  
 (c) Explain mechatronics design process in detail. [12]
3. (a) Explain 4 step sequence to convert impedance diagram in to block diagram [8]  
 (b) A basic rope–driven elevator system consists of a drive pulley attached to a gear box powered by an electric motor. The drive pulley is wrapped with a rope, one end of which is attached to a counterweight and the other end to the elevator cab. Construct impedance diagram for this system. Convert impedance diagram into block diagram and determine transfer function of the system. [12]

Or

3. (a) For the mass spring–damper combination shown in **figure** determine the equation relating  $f$  and  $x$ . The equation relating  $f$  and  $y$  and the equation relating  $x$  and  $y$ . Draw impedance and block diagrams. [10]



- (b) Explain conservation of mass and conservation of energy of fluid system. [10]
4. (a) Explain construction and operation of brushless DC motors. [5]  
 (b) Derive the motor equation for 4 phase PM stepper motor and construct the block diagram. [10]  
 (c) Explain various types of pumps. [5]
5. (a) Derive the expression for sensitivity of resistance transducer. [10]  
 (b) The resistance of a certain length of wire is given by  $R = \frac{4\rho l}{\pi d^2}$  [10]

Where  $\rho$  = resistivity of wire ohm–cm  
 $l$  = length of wire cm  
 $d$  = diameter of the wire cm

Determine the nominal resistance and the uncertainty in resistance of the wire with the following data :

$$\rho = 45.6 \times 10^{-6} \pm 0.15 \times 10^{-6} \text{ ohm – cm}$$

$$l = 523.8 \pm 0.2 \text{ cm}$$

$$d = 0.062 \pm 1.2 \times 10^{-3} \text{ cm}$$

6. (a) Draw a ladder diagram that could be used with a conveyor belt which is used to move an item to a work station. The presence of the item of the work station is detected means of breaking a contact activated by a beam of light of a photosensor. There it stops for loos for an operation to be carried out before moving an and off the conveyor. The motor for the belt is started by a normally open start switch and stopped by a normally closed switch. [6]

- (b) A three mode controller has  $K_p$  as 2,  $K_I$  as 0.1/s,  $K_D$  as 1.0 and a set point output of 50%. The error starts at zero and changes at 5% / s to zero and remains at zero. What will be controller output at (i) 0s, (ii) 3s (iii) 7s ? [8]
- (c) A relay in a liquid level controller is used to open or close the inlet valve. If the controller gives linear conversion of 3 – 4.5 meters of water in a reservoir into the standard signal and if the relay closes of 15 mA and opens at 12 mA, find (i) the relation between level and current and (ii) the differential gap in liquid level. [6]
7. (a) What is overframing ? Explain in detail. [6]  
 (b) How will you configure Vis Sim for real time operation ? Eight wire 1–2 amp 5 1.8° / step stepper motor to be run by using Vis Sim. Explain real time interface for this application and write Vis Sim program to control the position of stepper motor. [10]  
 (c) When will you use fuzzy logic? [4]

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### Mechatronics – December 2005

Time : 3 Hrs.]

[Marks : 100

- N.B. :**
- (1) Question No. 1 is compulsory.
  - (2) Answer any **four** questions out of remaining **six** questions.
  - (3) Assumptions made should be clearly stated.
  - (4) Assume any suitable data wherever required but **justify** the same.
  - (5) **Figures** to the **right** indicate **full** marks.
  - (6) Illustrate answers with **sketches** wherever **required**.
  - (7) Answer to question should be grouped and written together i.e. all answers to sub questions of individual questions like questions No. 1, 2, 3 etc. should be answered one below the other.
1. (a) Explain why a sequential design by discipline approach is not adopted in mechatronics design. [3]  
 (b) What is the role of information system in mechatronics ? [2]  
 (c) Distinguish between static and dynamic models. [4]  
 (d) What is hardware in the loop simulation ? what are the advantages over pure simulation ? [3]  
 (e) Explain of basic principle of Hall effect sensor. [4]  
 (f) Explain fuzzy logic system. [4]
2. (a) Draw the mechanical diagram of automobile suspension system. Construct impedance diagram and block diagram. Determine the transfer function of the system. [10]  
 (b) Explain restriction. Determine the general restriction equation for compressible fluids from continuity equations. [10]
3. (a) Explain series and parallel mechanical elements. What is grounded–chair representation? Explain. [10]  
 (b) Explain the basic principle of Piezoelectric transducer. Derive the expression for voltage. Draw the Mechanical diagram of Piezoelectric Accelerometer. [10]
4. (a) Explain construction of permanent magnet stepper motors. Derive motor equations and draw block diagram model of PM stepper motor. [10]  
 (b) Explain the following terms : [10]  
 (i) Hydraulic resistance (ii) Hydraulic Capacitance (iii) Pnenmatic intertance  
 (iv) Thermal Capacitance (v) Damper model.
5. (a) A capacitance transducer consist of two plates of diameter 2 cm each, separately on air gap of 0.25 mm. Find the displacement sensitivity. [5]  
 (b) Give proportional and integrator compensator design steps. Design PI compensator to modify the behavior of the plant. [10]
- $$G_x(S) = \frac{1}{S^2 + 9S + 18}$$
- Such that the following performance specifications are met :
- (i)  $e_{ss}(\text{step}) = 0$  (ii) The system is stable (iii)  $\tau \leq 0.5$  sec.
- (c) Explain operating principle of electromagnetic flow meter and determine the induced voltage [5]
6. (a) Explain major components of Data Acquisition and control system. [10]  
 (b) Explain features of Vis Sim Software. Explain configuration of Vis Sim for real time operation. [10]
7. (a) What is the use of internal relay in PLC ? How will you construct ladder diagram of master relay ? [5]  
 (b) Construct a ladder diagram that could be used with a domestic washing machine to switch on a pump to pump water for 100 sec in to the machine, then switch off and switch on a heater for 50 sec to heat the water. The heater is then switched off and another pump is to empty the water from the machine for 100 sec. [10]  
 (c) What is Microsensor ? Give the basic fabrication process steps of microsensor. [5]

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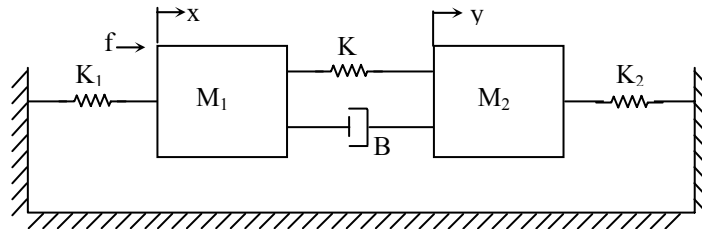
## Mechatronics – May 2006

Time : 3 Hrs.]

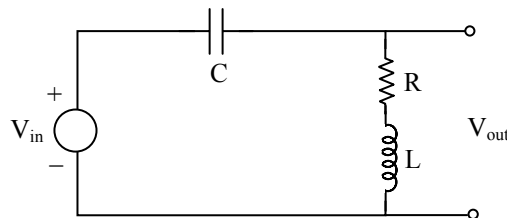
[Marks : 100

- N.B. :**
- (1) Question No. 1 is compulsory.
  - (2) Answer any **four** questions out of the remaining **six** questions.
  - (3) Assumptions made should be **clearly** stated.
  - (4) Assume any **suitable** data wherever **required** but justify the same.
  - (5) Figures to the **right** indicate **full** marks.
  - (6) Illustrate answers with **sketches** wherever **required**.
  - (7) Answer to question should be **grouped** and written together i.e. **all** answers to sub questions of individual questions like questions No. 1, 2, 3 etc. should be answered **one below the other**.
  - (8) Use **legible** handwriting. Use a **blue/black ink pen** to write answers. Use of **pencil** should be done only to **draw diagrams** and **graph**.

1. (a) Why do you need information systems in mechatronics design? [2]
  - (b) What are the advantages of modified analogy approach over conventional analogy approach in impedance diagram? [2]
  - (c) How will you select summing junction in impedance diagram to block diagram conversion? [2]
  - (d) When the surface between twobodies is lubricated, the frictional force will initially decrease as velocity is increased and will then increase as velocity is further increased. Explain why. [3]
  - (e) Why do you need error analysis of sensors in mechatronic technology? [2]
  - (f) What is the difference between fluid pump two fluid motor? [2]
  - (g) Can we use derivative control alone? If no, why? [2]
  - (h) What are the advantages of Adaptive control? [2]
  - (i) How will you draw ladder diagram for conditional jump? [3]
2. (a) Explain various controls involved in intelligent supervisory control structure [5]
  - (b) Explain general procedure for constructing the grounded chair representation of mass-spring-damper model. Consider the following mass-spring-damper system shown in **figure**. Convert this system into grounded chair form and determine the equation of force f. [10]



- (c) Compute the block diagram representation for the following electrical circuit shown in figure. [5]



3. (a) Explain various properties of sensors. [10]
  - (b) What are the advantages and disadvantages of the plastic film type of potentiometer when compared with the wire wound potentiometer? [4]
  - (c) A Hall element width dimensions  $4 \times 4 \times 2$  mm is used to measure flux density. The Hall coefficient H is  $-0.8V\text{-m per A-Wb/m}^2$ . Find the voltage developed if the field strength is  $0.012\text{Wb/m}^2$  and the current density is  $0.003\text{A/mm}^2$ . [4]
  - (d) What is microsensor? [2]
4. (a) Draw the stepper motor system top level block diagram. Construct motor equation and block diagram model four phase PM stepper motor. Why do you need block diagram model? [10]
  - (b) Explain how a sequential valve can be used to initiate an operation only when another operation has been completed. [5]
  - (c) Explain the principle of brushless dc permanent magnet motor. [5]
5. (a) Draw the ladder rings to represent : [10]
    - (i) Two switches are normally open and both have to be closed for a motor to operate.
    - (ii) Either of two, normally open, switches have to be closed for a coil to be energised and operate an actuator.
    - (iii) A motor is switched on by pressing a spring return push button start switch and the motor remains on until another spring-return push-button stop switch is pressed.
  - (b) Draw a ladder diagram that could be used with a domestic washing machine to switch on a pump to pump water for 100sec. into the machine, then switch off and switch on a heater for 50sec to heat the water. The heater is then switched off another pump is to empty the water from the machine for 100sec. [10]

6. (a) Explain various tuning methods of PID controller. [5]  
 (b) When tuning a three mode control system by the ultimate cycle method it was found that oscillations began when the proportional band was decreased to 20%. The oscillations had a periodic time of 200sec. What are the suitable values of  $K_p$ ,  $T_I$  and  $T_D$ ? [5]  
 (c) Explain with example root locus sketching steps of feedback system. [5]  
 (d) Compute the steady state parabolic error for a basic feedback system with  $G(s) = \frac{10}{s^2}$  and  $H(s) = 1$  [5]
7. (a) A force of cantilever beam is to be measured. Draw the system diagram and block diagram model. Explain hardware/ software needed to implement hardware in loop of this system. [10]  
 (b) Explain the basic function of the various components of Data Acquisition and Control system. [5]  
 (c) What are the applications of fiber optic devices in mechatronics? [5]

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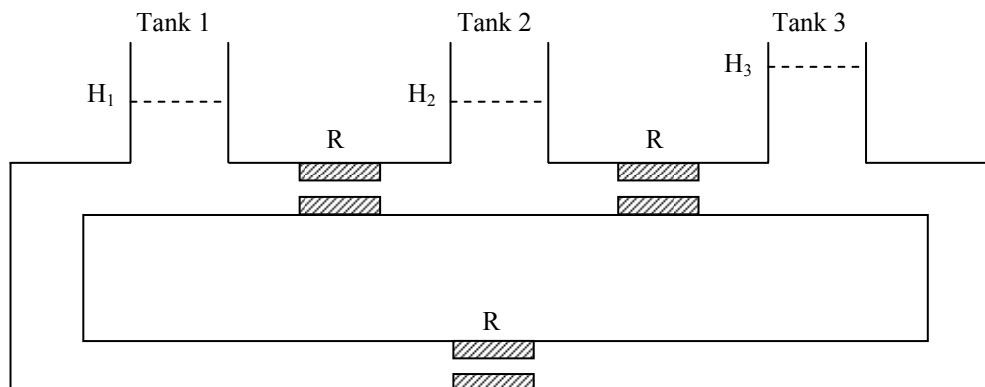
**Mechatronics – December 2006**

**Time : 3 Hrs.]**

**[Marks : 100**

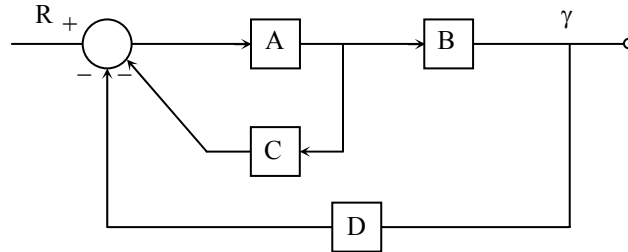
- N.B. :** (1) Question No. **1** is **compulsory**.  
 (2) Answer any **four** questions out of remaining **six** questions.  
 (3) Assumptions made should be clearly stated.  
 (4) Assume any **suitable** data wherever **required** but justify the **same**.  
 (5) **Figures** to the **right** indicate **full** marks.  
 (6) **Illustrate** answers with sketches wherever **required**.  
 (7) Answer to question should be grouped and written together i.e. all answers to sub questions of individual questions like questions No. **1, 2, 3** etc. should be answered one below the other.  
 (8) Use **legible** handwriting. Use a **blue/black** ink pen to write answers. Use of pencil should be done only to draw diagrams and graph.

1. (a) Define : [5]  
 (i) Modeling (ii) Simulation (iii) Dynamic Model  
 (iv) Hall effect principle (v) Process lag  
 (b) Give the list only : [5]  
 (i) Types of pressure control valves and volume control valves.  
**Or**  
 (ii) Cylinder and Gears type.  
 (c) What is need of dead band in two step Controller. [2]  
 (d) Can we use derivative control alone? If no. why? [2]  
 (e) When will you use fuzzy logic? [3]  
 (f) Write down the step's for installation of I/O cards and software. [3]
2. (a) Write a fundamental laws, which is used most mechatronics application involve rigid body system. [5]  
 (b) Explain any one application for fiber optic devices in mechatronics. [5]  
 (c) Explain mechatronics design process. [10]
3. (a) Draw diagram of cantilever Beam force measurement and Wheatstone Bridge circuit diagram only. [4]  
 (b) Explain element of data Acquisition and Control system. [6]  
 (c) Explain various mechatronic control in automated manufacturing. [10]
4. (a) Give the list of the electrical components in fluid power circuit. [2]  
 (b) Explain in short control modes of fluid power circuits. [4]  
 (c) Explain in short fluid power energy input devices. [4]  
 (d) Derive the motor equation and block diagram model of 4 phase P.M. stepper motor. [10]
5. (a) The system consists of three cylindrical tanks all connected in series by pipes. Systems of this type may be applied to modeling the "Slosh" of fluid in large baffled tanks such as those found in ship and aircraft tankers. The three – tank system is presented in **figure**.

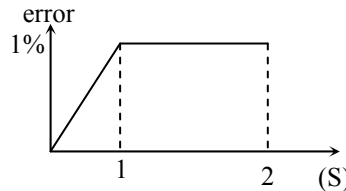


- (i) Draw impedance diagram [5]  
 (ii) The complete block diagram. [5]

- (b) Explain fundamental impedance relationship. [5]
- (c) Compute the loop transfer function L.T.F, CLTF. [5]



6. (a) Three mode controller having  $K_P$  as 4,  $K_I$  as 0.6/s,  $K_D$  as 0.5s, a set point output of 50% and subject to the error change shown. [10]



- (i) Immediately the change starts to occur and
  - (ii) 2's after its starts. Using the equation given above for  $I_{out}$ .
- (b) Devise a system, using a PLC which can be used to control the movement of piston in a cylinder so that when a switch a momentarily pressed, the piston moves in one direction and when second switch is momentarily pressed the piston moves in other direction. [10]  
Hint : you might consider using a 4/2 solenoid controlled valve. Draw ladder diagram with system diagram.
7. (a) Explain in short velocity control with diagram. [5]  
(b) Draw a ladder diagram of Basic NOT, AND, OR, LOGICS. [5]  
(c) Write four step sequence to convert impedance diagram in block diagram. [4]  
(d) Explain any one monitoring mode with system and block diagram. [6]

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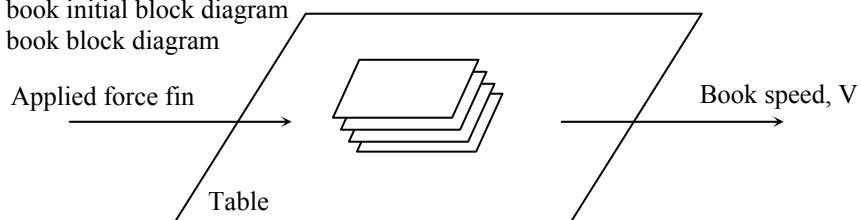
### Mechatronics – May 2007

Time : 3 Hrs.]

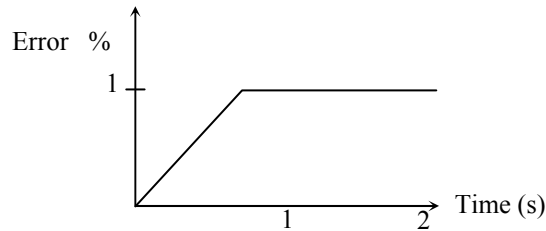
[Marks : 100

- N.B.:
- (1) Question No. 1 is compulsory.
  - (2) Attempt any **four** out of remaining **six** questions.
  - (3) Assume any **suitable** data wherever **required** but justify the **same**.

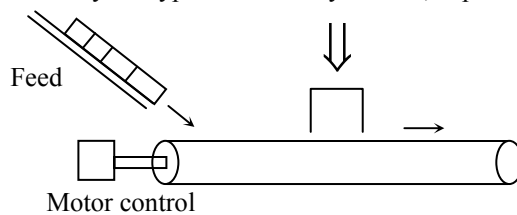
1. Solve any Five :-
- (a) Define piezoelectric principal, Hall effect principle seeback effect, peltier effect. [4]
  - (b) Give the list pressure control valves & volume control valves write where it is used. [4]
  - (c) Write a fundamental laws, which is used most mechatronics application involve rigid body system. [4]
  - (d) Define proportional Band, which is used band give any one practical example. [4]
  - (e) Explain in short control modes of fluid power circuit. [4]
  - (f) Draw a ladder diagram of basic NOT & AND logics. [4]
2. (a) Distinguish between static & dynamic models. [4]  
(b) Explain Key element of mechatronics. [4]  
(c) Explain in details Mechatronics design process diagram, operation & importance. [12]
3. (a) Explain in brief over framing how it will avoid [6]  
(b) Explain installation procedure of I/o cards & Vis-sim Software steps. [6]  
(c) Explain importance in mechatronics artificial intelligence in mechatronics [8]
4. (a) Explain and Draw the permanent stepper motor principle diagram and derive the motor equation with block diagram model of 4 phase PM Stepper motor. [12]  
(b) Explain microsensors fabrication techniques with diagram. [8]
5. (a) To illustrate how the three types of friction are used, we consider an example in which a book is slid across a desk at a specific velocity V the book consists of a simple mass and encounters friction with the table as it slides. The situations illustrated in figure 1 draw [10]
- (i) sliding book impedance diagram
  - (ii) sliding book initial block diagram
  - (iii) sliding book block diagram



- (b) Explain range sensor with any application [5]
- (c) Explain PID tuning methods. [5]
- 6. (a) Explain in details adaptive control and velocity control different types with diagram. [12]
- (b) Three mode controller having  $K_P$  as 4,  $K_I$  as 0.6  $K_D$  as 0.5s a set point output 50% and subject to the error change shown in figure A what will be the controller output (a) change starts to occur (b) 2 sec after the starts. [8]



- 7. (a) Explain PLC programming features of programmable controller and selection procedure. [8]
- (b) A bottling plant uses an automated mechanism for filling the containers and transporting them from one point to another as shown in figure AA the sensors monitor the amount of solid or liquid filled a conveyer mechanism the transport the containers, design a mechatronics system with the help of PLC, the case described identify the types of sensors you used, explain how interface control system. [12]



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### Mechatronics – December 2007

Time : 3 Hrs.]

[Marks : 100

- N.B.:**
- (1) Question No.1 is compulsory.
  - (2) Attempt any **four** questions out of remaining **six** questions.
  - (3) Assume suitable **additional data** if **necessary** and state them clearly.
  - (4) Draw **neat** diagram and sketches.

- 1. Solve any **four** (5 marks each) [20]
  - (a) Give the list of gear types and draw any two diagram of gears.
  - (b) Give the list of cylinders types and explain any two diagram of cylinder.
  - (c) Comparison between Static and Dynamic models with examples.
  - (d) Define following terms with proper examples :-  
Proportional band, Dead band, Process lag, Process lead
  - (e) Draw PLC ladder programming rungs steps of motor forward reversed application.
- 2. (a) Explain mechatronics design process in details with diagram. [10]
- (b) Explain mechatronics control in Automated manufacturing in details with diagram. [10]
- 3. (a) Draw the mechanical diagram of automobile suspension system construct impedance diagram and block diagram, determine the transfer function of the system. [10]
- (b) Explain construction and operation of principal of brushless DC motor. [5]
- (c) Explain operation of principal of Stepper motor with waveforms. [5]
- 4. (a) Explain various properties of sensors. [5]
- (b) Explain various controlled in intelligent supervisory control structure. [5]
- (c) Explain major components, of Data acquisition and Control system. [10]
- 5. (a) What is the internal Block diagram of PLC ? How flow chart of PLC operation and ladder diagram perform the task of any application ? [12]
- (b) Construct the ladder diagram of : [8]
  - (i) Conditional jump rung
  - (ii) Timer on rung
  - (iii) Timer off rung
  - (iv) Counter rung
- 6. (a) Explain needs of PID controller with Any one application with justification. Draw P, PI, PD, PID controller step input; ramp input response output waveforms. [15]
- (b) Write the steps the installation of I/O cards and software. [5]
- 7. Short notes on any four (5 marks each) : [20]
  - (a) Fluid Power Circuit.
  - (b) Micro Sensors
  - (c) Various Tunings methods of PID
  - (d) Fuzzy Logic
  - (e) Over framing

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**Mechatronics – May 2008****Time : 3 Hrs.]****[Marks : 100**

- N.B.:** (1) Question No. 1 is compulsory.  
 (2) Attempt any **four** out of remaining **six** questions.  
 (3) Assume **suitable** data wherever **required** and justify the **same**.

1. Answer any four of the following : [20]
  - (a) Explain the importance of real time interfacing system in mechatronics ? State the different types of the interface systems.
  - (b) What is simulation of mechatronics systems ? Explain the basic functions and different steps in simulation process of mechatronic systems.
  - (c) Give the classification of the different types of sensors used in mechatronics and explain them.
  - (d) Write fundamental laws, which are used in mechatronics where applications involved with rigid body systems are used.
  - (e) Explain fluid power energy input devices.
2. (a) What are the advanced approaches in mechatronics ? Explain it with the help of model based monitoring system. [10]
  - (b) For the transformer with input voltage  $V$ ,  $N_1$  and  $N_2$  be the number of turns of primary and secondary winding respectively,  $R_1$  and  $L_1$  a series resistance and inductance at the primary,  $Z_{load}$  – the load impedance at the secondary coil,  $I_1$  and  $I_2$  the primary and secondary current. Draw the transformer circuit, transformer impedance diagram and transformer block diagram. [10]
3. (a) For a permanent magnet stepper motor. Derive and explain the top level block diagram and drive circuit model. Hence give block diagram for four phase PM stepper motor model. [12]
  - (b) Explain the importance of zero and span circuit. Design a zero and Span circuit for a pressure sensor and A/D converter for the following specifications,  $P$  –pressure,  $V_T$  –Sensor output,  $V_O$  –Output of amplifier at  $P = 0$ ,  $V_T = 1.2V$ ,  $V_O = 0V$  at  $P = 100$  psia,  $V_T = 2.2V$ ,  $V_O = 5V$ . [8]
4. (a) Design a PI controller using Bode Technique for the plant  $G(s) = \frac{1}{(s+10)}$ , such that following performance spec are met,  $ess(\text{step}) = 0$ ,  $ess(\text{ramp}) \leq 0.05$ ,  $\xi = 1$ ,  $\tau = 0.1$  sec. The system is stable. [12]
  - (b) What is Fuzzy control ? Explain the elements of Fuzzy logic system. [8]
5. (a) Device a circuit that could be used with a conveyor belt which is used to move an item to a work station. The presence of the item is detected by means of a breaking a contact activated by a beam of light to a photosensor. There it stops for 100 S for an operation to be carried out before moving on and off the conveyor. The motor and the belt is started by a normally open start switch and stopped in normally closed switch. [10]
  - (b) Explain various methods of PID controller tuning. [5]
  - (c) Explain the basic functions of various components of DAS and control system. [5]
6. (a) Explain series and parallel mechanical elements. What is grounded-chair representation? Explain. [10]
  - (b) Three mode controller has  $K_p$  as 2,  $K_I$  as 0.1 /s,  $K_D$  as 1.0 s and a set point output of 50%. The error start at zero and changes at 5% /s for 2 s before becoming constant for 3 s. It then decreases at 2% to zero and remains at zero. What will be the controller output at (i) 0 sec, (ii) 3 sec, (iii) 7 sec ? [10]
7. Write short notes on the following : [20]
  - (a) Velocity Control.
  - (b) Converting impedance diagram into block diagram.
  - (c) Micro-sensors.
  - (d) Over-framing.

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**Mechatronics – December 2008****Time : 3 Hrs.]****[Marks : 100**

- N.B.:** (1) Question No. 1 is compulsory.  
 (2) Attempt any **four** questions out of remaining **six** questions.  
 (3) Assume **suitable** data wherever **required**.

1. Answer any four of the following:
  - (a) Give different types of volume control valves and explain in brief. [5]
  - (b) Explain various controls involved in intelligent supervisory control system. [5]
  - (c) What are the conditions for connecting mass in mechanical system? What is grounded – chair representation of mass? [5]
  - (d) Why PI controller is called industrial controller? [5]
  - (e) Draw ladder diagram of – [5]
    - (i) An XOR System
    - (ii) Latch.

2. (a) Explain in detail Mechatronics design process diagram, operation and importance. [10]  
 (b) What are design steps of lead compensator design a lead controller using root locus technique to modify the behaviour of the plant. [10]
- $$G \times (s) = \frac{1}{(s^2 + 1)}$$
- such that following specification are met:  
 (i)  $\xi \geq 0.707$  (ii)  $\tau \leq 0.1$  sec (iii) System is stable.
3. (a) Draw the mechanical diagram of automobile suspension system, construct impedance diagram, block diagram. Determine the transfer function. [10]  
 (b) Explain the basic principle of piezoelectric transducer. Derive the expression for voltage. Draw mechanical diagram of Piezoelectric Accelerometer. [10]
4. (a) What are energy modulation devices? Give it's classification and explain the same. [10]  
 (b) Explain the following terms: [10]  
 (i) Hydraulic resistance  
 (ii) Hydraulic capacitance  
 (iii) Pneumatic inertance  
 (iv) Thermal capacitance  
 (v) Damper model.
5. (a) What is adaptive control system? Compare the performance of different types of adaptive control system. [10]  
 (b) Explain major components of Data acquisition and control system. [10]
6. (a) How will you configure Vis-Sim for real time operation? Eight wire 1-2 amp 5 Ohm 1.8% step stepper motor to be run by using Vis-Sim. Explain real time interface for the application and write Vis-Sim program to control the position of stepper motor. [10]  
 (b) How PLC is selected for particular application. [5]  
 (c) Device a system using PLC which can be used to control the movement of the piston in a cylinder so that when a switch is momentarily pressed the piston moves in another direction. [5]
7. Write short notes on: [20]  
 (a) Microsensor (c) Brushless D.C. Motor  
 (b) Neural Network (d) Digital PID Controller.

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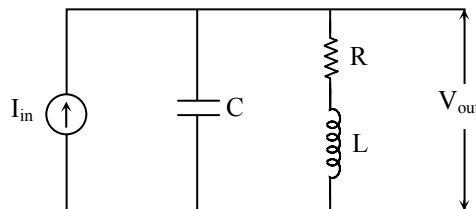
### Mechatronics – May 2009

Time : 3 Hrs.]

[Marks : 100

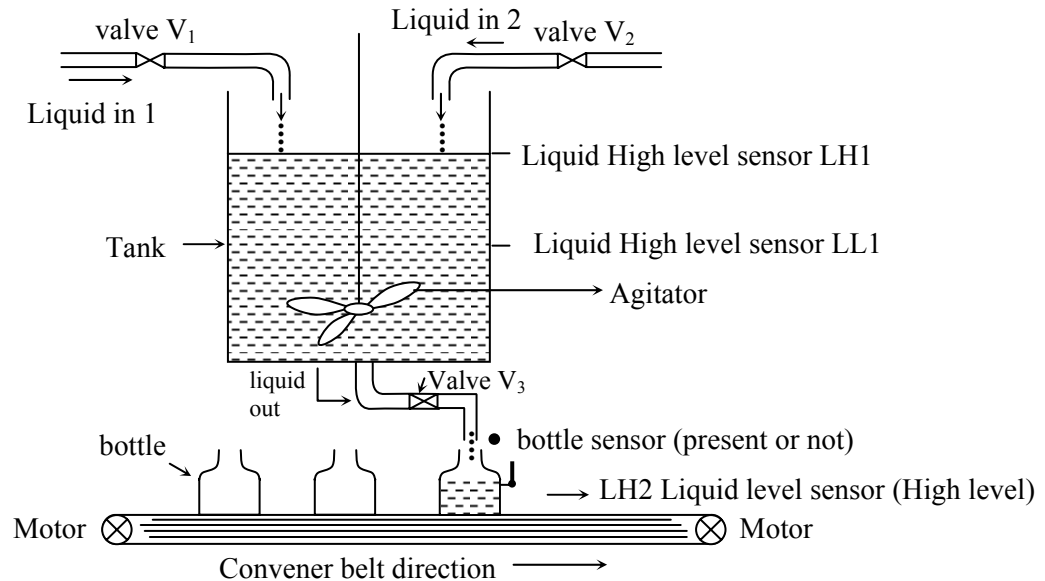
- N.B. :** (1) Question No. 1 is compulsory.  
 (2) Attempt any **four** questions out of remaining **six** questions.  
 (3) Assume suitable data whenever **required** but justify the **same**.  
 (3) Illustrate answers with sketches wherever **required**.  
 (4) Figures to the **right** indicate **full** marks.

1. Answer any four of the following :  
 (a) What is mechatronics ? Which are the key elements of mechatronics ? Explain in brief. [5]  
 (b) Give the list of gear types and draw any two diagrams of gears. [5]  
 (c) Explain the importance of real time interfacing system in mechatronics. State different types of the interface system.  
 (d) Explain various controls involved in intelligent supervisory control system. [5]  
 (e) There are two push buttons SW<sub>1</sub> and SW<sub>2</sub>, if any one is pressed motor ON for 10 minutes then switch OFF and switch ON heater for 5 minutes. Stop buttons SW<sub>3</sub> and SW<sub>4</sub> are provided individually to stop motor and heater. Draw the ladder diagram and explain its logic. [5]
2. (a) Explain mechatronics design process in details with diagram. [10]  
 (b) Compute the block diagram representation for following electrical circuit. [10]



3. (a) Explain construction and operation of brushless DC motor. [10]  
 (b) Explain major components of Data Acquisition and Control System. [10]
4. (a) Explain the basic principle of piezoelectric transducer. Derive the expression for voltage. Draw mechanical diagram of piezoelectric accelerometer. [10]  
 (b) Explain any one application for fiber optic device in mechatronics. [10]

5. (a) Explain PLC with the help of block diagram. Also explain selection procedure and features of PLC. [8]  
 (b) Draw the ladder diagram and explain logic for following automated bottling plant is as shown in [12]  
 figure.



As start push button pressed following process chart.

- (i) If liquid level below LH1 sensor valve V<sub>1</sub> and V<sub>2</sub> open otherwise close.
  - (ii) If liquid level above LL1 sensor agitator ON otherwise OFF.
  - (iii) Valve V<sub>3</sub> opens when liquid level above LL1 sensor and bottle is present below valve V<sub>3</sub> but it should be empty or liquid level in bottle below LH2 sensor.
  - (iv) If liquid level in bottle touches to LH2 sensor convener belt motor start and when next empty or liquid level in bottle below LH2 sensor comes convener below motor stops.
6. (a) Explain P, PI, PD, PID controller with the help of circuit diagram. Also draw the output waveforms [12]  
 for step input and ramp input.  
 (b) What is adaptive control system ? Compare the performance of different types of adaptive control [8]  
 system.
7. Write short notes on any four :
- (a) Various properties of sensor [5]
  - (b) Fuzzy logic [5]
  - (c) Various tunings methods of PID [5]
  - (d) Stepper motor [5]
  - (e) Fluid power circuit [5]



### Mechatronics – December 2009

Time : 3 Hrs.]

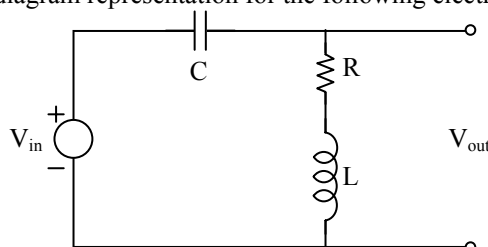
[Marks : 100

- N.B.:
- (1) Question No. 1 is compulsory.
  - (2) Attempt any **four** questions out of remaining **six** questions.
  - (3) Assume suitable data whenever **required** but justify the **same**.
  - (3) Illustrate answers with sketches wherever **required**.
  - (4) Figures to the **right** indicate **full** marks.

1. Answer any four of the following :
- (a) Give different types of volume control valves and explain in brief. [5]
  - (b) What is mechatronics ? Which are the key elements of mechatronics ? [5]
  - (c) Give the list of gear types and draw any two diagrams of gears. [5]
  - (d) Why PI controller is called industrial controller ? [5]
  - (e) Draw ladder diagram of : [5]

If start switch is pressed Motor 1, Motor 2, Motor 3 start.  
 If stop switch is pressed after 10 sec. Motor 1 stop then after 10 sec. Motor 2 stop then after 10 sec.  
 Motor 3 stop.

2. (a) Explain in detail Mechatronics design process diagram, operation and importance. [12]  
 (b) Compute the block diagram representation for the following electrical circuits shown in figure. [8]



3. (a) Explain various properties of sensors. [10]  
(b) Explain construction and operation of brushless DC motor. [10]
4. (a) What is adaptive control system ? Compare the performance of different types of adaptive control system. [10]  
(b) Explain major components of data acquisition and control system. [10]
5. (a) Draw the block diagram of PLC and explain each block in detail. Also explain selection procedure and features of PLC. [8]  
(b) Draw the ladder diagram for the following : [12]  
If start switch is pressed after 10 sec. Motor M1 start then after 10 sec. Motor M2 start but Motor M1 stop then after 10 sec. Motor M3 start but Motor M2 stop. Then after 10 sec. Motor M1 start but Motor M3 stop.
6. (a) Explain P, PI, PD, PID controller with the help of circuit diagram. Also draw the output waveforms for step input and ramp input. [12]  
(b) What are the application of fiber optic devices in mechatronics. [8]
7. Write a note on : [20]  
(a) Stepper motor  
(b) Various tuning methods of PID  
(c) Neural Network  
(d) Fluid power circuit

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