MAJOR

Biomedical Electronics EEL836 / Medical Electronics EEL314

Time: 2 Hours **Max. Marks: 40**

N.B.:- Attempt all questions.

Q1:- In an intensive care unit (**BP**) blood pressure (Diastolic, in mm Hg) and (**T**) body temperature (In degrees Fahrenheit) are monitored continuously to control the (**F**) flow rate (In liters per hour) of medicines mixed in saline.

Triangular membership for each fuzzy set is assumed for composition:

BP_{LOW}	(60, 80, 100)
BP_{MEDIUM}	(80, 100, 120)
BP_{HIGH}	(100, 120, 140)

[**Hint:** BP_{HIGH} implies that for crisp value of 'BP' the grade of membership is '0' at 100 and 140 whereas it is '1' at 120 and the shape is triangular.]

For temperature:

T_{LOW}	(95, 97, 99)
T_{MEDIUM}	(97, 99, 101)
T_{HIGH}	(99, 101, 103)

For flow rate:

F_{LOW}	(0.5, 0.7, 0.9)
F_{MEDIUM}	(0.9, 1.1, 1.3)
F_{HIGH}	(1.3, 1.5, 1.7)

If the two fuzzy rules are as:

(a) **If (BP is BP_{LOW}) OR (T is T_{LOW}) then (F is F_{HIGH})**

(b) **If (BP is BP_{MEDIUM}) OR (T is T_{MEDIUM}) then (F is F_{MEDIUM})**

(c) **If (BP is BP_{MEDIUM}) AND (T is T_{LOW}) then (F is F_{LOW})**

If the temperature is 98 ^{0} F and BP = 85 mm Hg, Find the approximate crisp value of F. **(5)**

Q2:- Draw a **Neat schematic-diagram** and make a self explanatory **flow-chart** with appropriate remarks for 8086-based **kilo-watt-hour meter** (Domestic meter) which is going to be used for stationary and in use power consumption by treadmill. Assume the following:

(a) Expenditure of energy by patient may be computed by difference in power use.

(b) Output device for the control and measurement unit is nine digit LCD-display and is incremented for every **0.1** Kilo-watt-hours power used.

(c) In flow-chart compute power and show the use NMI for power failure routine.

(d) In the design kit the following things are available:
8086-CPU board with any desired numbers of ports, **A to D** converters, **D to A** converters, voltage transformer, current transformer, Hall sensor, **LCD** display, Timers of desired durations and other peripheral devices.
Assume any thing which you need and be very clear in the implementation of algorithm for updating the display. Take care of your readings even for the case of power failure. **(8)**

Q3:- Write **strictly in between 20 and 50** words on (**Any three for EEL836 and any two for EEL314**) of the following:

(I) Use of Piezo electric transducers (along with limitations) in biomedical.
(II) Thermister and diode as temperature sensors (comparison) in biomedical.
(III) EEG and its relevance in medicine. Major difficulties in recording EEG.
(IV) Factors affecting ultrasound frequency selection for biomedical.
(V) Issues in incubator design. Needs and problems associated with neonates.
(VI) List factors affecting CMRR in instrumentation-amplifier and remedies.

(7)

Q4:- Write **strictly in between 50 and 100** words on (**Any three for EEL836 and any two for EEL314**) of the following:

(a) DSP chips and their distinguishing features for biomedical applications as compared to general purpose microprocessors in decreasing order of importance.
(b) Use of **Peltier-effect** based system in biomedical. Main advantages and disadvantages. Scheme (Circuit diagram) how to drive Peltier based controller.
(c) Mention main electrode types with their merit and demerits. Discuss distinguishing features of Ag-Ag Cl electrodes with applications and limitations.
(d) Using Einthoven triangle arrangement for electrodes, select the lead combination with maximum signal amplitude (give reason). Suggest the ideal set of conditions for connection of patient to an **E.C.G.** machine.
(e) Volume time measurement system in Spiro meters. Computation of flow volume (with problems associated) and its relevance in biomedical.
(f) With schematic diagram discuss CPAP (continuous positive air pressure) machine and its use. Discuss the enhancements in features which are being done.

(13)

Q5:- Using operational amplifiers and AD590 design a Fahrenheit thermometer with the given guidelines.

(1) To convert from Celsius to Fahrenheit: multiply by 1.8 and add 32.

$$^{\circ}F = 1.8^{\circ}C + 32 \text{ AND } ^{\circ}K = ^{\circ}C + 273.$$

(2) **AD590** gives a change of one micro ampere per degree Kelvin.
(3) Resistances available in laboratory are all standard values between 10 K. Ohm and 1 M. Ohm.
(4) The circuit output should give 98.6 mili volts for normal human subjects and should be able to record maximum up to boiling water temperature.
(5) Mention gain of each stage and highlight add/subtract voltages as well.
(6) Use suitable capacitor at appropriate location to have an upper cut-off of 5 Hz.

(7)