IDL 711 MAJOR 01-12-06

Max Time 2 hours **Max Marks 60**

Answer all Questions. Answer to the point with neat diagrams where needed

Q-1 (a) Explain using suitable diagram why sensitivity and resolution are contradictory requirements in a wire wound potentiometer? (2 marks)

(b) How using a conducting paste modifies the limitation? (2 marks)

Q-2 Explain with suitable diagram

a) Working of ultrasonic flow meter (3 marks)
b) Working of turbine flow meter (3 marks)
c) Compare four important performance differences of (a) & (b), w.r.t. threshold detection, span, type of fluid, accuracy. (2 marks)

Q-3 a) Give a neat diagram of smart sensor. Tabulate the main differences between a conventional and smart sensor? (3 marks)
b) What additional features does an intelligent sensor have over smart sensor? (3marks)

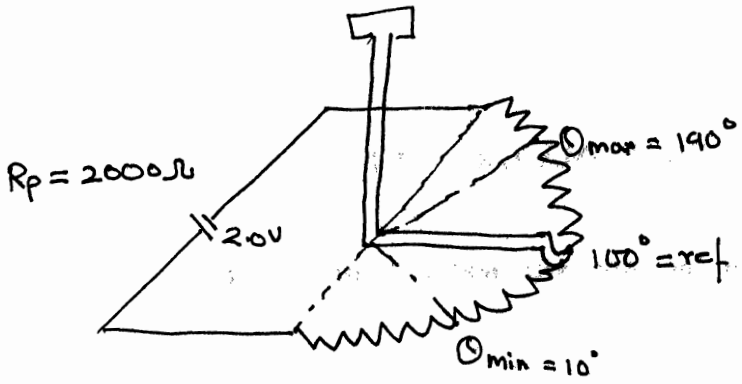
Q-4 a) Draw the diagram of 4 wire RTD. (2 marks)
b) Explain :-
(1) How a 4 wire RTD reduces lead length error as compared to a 2 wire RTD. (2 marks)
(2) How a 4 wire RTD induces less noise in bridge output detection compared to a 2-wire RTD? (2 marks)

Q-5 a) For a fully active strain gauge bridge, derive the bridge o/p voltage e_0 in terms of strain ε, Gauge factor G and excitation voltage E. (4 marks)
b) If Rgage=250Ω, G=2 and E=12V, Calculate e_0 for $\varepsilon = 10^{-4}$. (2 marks)

Q-6 Draw circuit diagram of half wave precision rectifier and plot the o/p voltage V_0 Vs time if the input voltage V_{in} is $V_{in} = 2.5 \sin(250\pi t)$ volts. (4 marks)

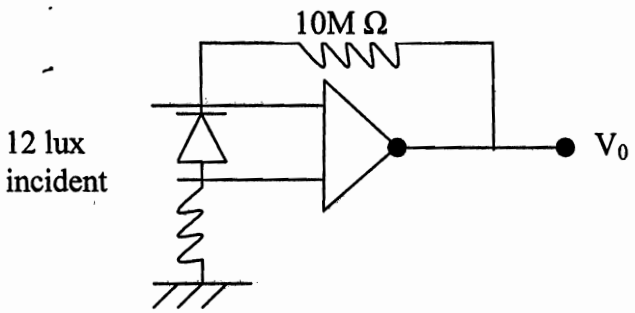
Q-7 Explain working of synchronous detector with the help of suitable block diagram and waveforms. (4 marks)

Q-8 The angular motion of a robotic arm is to be measured by a semicircular potentiometer as shown in figure. The initial position of robotic arm is 100^0 and maximum possible rotation is 200^0 and it is to move & measure $\theta = \pm 90^0$ about initial position. The output voltage is required to be zero at initial position the total span of output voltage is ± 9V.
The rotary arm length is 50mm, wire diameter of 50μm.



a) Give complete circuit diagram to achieve the above. (2 marks)
b) Using loading error<1%, calculate all resistances values in circuit. (2 marks)
c) Calculate angular resolution in degrees. (2 marks)

Q-9



Photodiode sensitivity is 0.3nA per lux. Calculate the voltage output? (2 marks)

Q-10 A strain gauge for load cell application has to give a 20mV calibrated response from a strain of $\varepsilon = 10^{-3}$ in a full bridge configuration. If the gauge factor is 10 & R=150 Ω, the supply voltage varies from 8 volts to 10V, Find the min value of sensitivity adjustment potentiometer? (4 marks)

Q-11 The capacitance in pF of a rotary capacitance transducer varies as

$C = (100+0.2\theta)$ with θ in deg. $\theta \rightarrow 0^0$ to 100^0.

It is proposed to measure the angle by using suitable conditioning method.
(a) What inductor value should be chosen to give resonant frequency = 1Mhz (1 marks)
(b) What choice of reference oscillator frequency will you make and plot Δf Vs θ for this choice? (2 marks)
(c) What is the required resolution of frequency counter to read $\Delta\theta = 1^{"}$? (2 marks)

Q-12 Explain with the help of neat block diagram the basic principle of detection of a chemical substance using piezo electric effect. Draw the block diagram for electron conditioning that can be used for above? (5 marks)