Name of Paper	**: Analog Systems and Applications**
Name of the Course	**: B.Sc. (Prog.) Chemistry**
Semester	**: IV**
Duration	**: 3 Hours**
Maximum Marks	**: 75**

2022

Attempt any four in questions.
All questions carry equal marks.

Q. 1. (*a*) Sketch the variation of the space charge, deplection region, electric field and electrostatic potential barrier as a function of distance across the junction, for an unbaised $p - n$ Junction. Obtain an expression for the width of depletion region for an unbiased $p - n$ Junction diode. (15)

(*b*) Determine the forward bias voltage applied to a silicon diode to cause a forward current of 10*m*A and reverse saturation current of 2.5μA at room temperature. (3.75)

Q. 2. (*a*) In a full-wave rectifier, the voltage applied to each diode is 240sin377t, the load resitance is 20000Ω and each diode has a forward resistance of 400Ω. Determine the (*i*) Peak, average and *rms* value of current (*ii*) efficiency of the rectifier and (*iii*) ripple factor. (7)

(*b*) Determine the maximum allowable Zener current for a Zener diode (20V, 1200*m*W) working as a voltage regulator. Also determine the range of input voltage to keep Zener diode under regulation if the values of limiting resitance and the fixed load resitance are 1*k*Ω and 20*k*Ω respectively. Support your answer with the voltage regulator circuit diagram. (8)

(*c*) Give two advantages and two limitation of using a LED. What is the wavelength of emitted electromagnetic radiation if the band gap value of a semiconductor is 1.43eV. (3.75)

Q. 3. (*a*) Describe the construction of a transistor including emitter, base and collector. Explain how current flows due to charge carriers in *npn* transistor. (3.75)

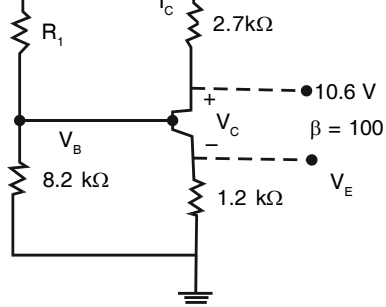
(*b*) Define current gain in CB configuration (α) and current gain in CE configuration (β). Derive the relation between them.

(*c*) Find the following for the circuit below :

(*i*) I_C (*ii*) V_E

(*iii*) V_{CC} (*iv*) V_{CE}

(*v*) V_B (*vi*) R_t



Q. 4. (*a*) Draw the circuit diagram of an RC coupled amplifier. Give the AC equivalent circuit in low, mid and high frequency range and state the associated assumption for each frequency range. Derive an expression for voltage gain in low frequency region. (8.75)

(*b*) Define stability factor. Explain how addition of emitter resistance enchances stability of the fixed basis circuit. (6)

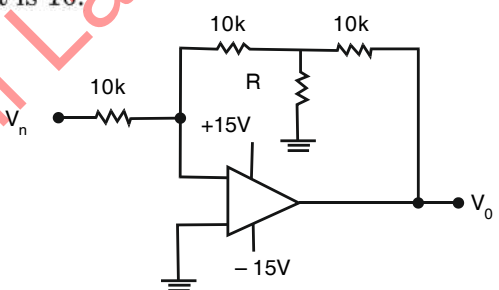
(*c*) For an *npn* transistor $\alpha = 0.98$, $I_E = 10mA$ and the leakage current ICBO = 0.4 Calculate the values of I_C.I_B, a and I_{CEO}. (4)

Q. 5. (*a*) An amplifier has a mid-biased gain of 100 and a based with of 250. If 4's feedback is find the new based width and gain. (4)

(*b*) Derive the expression for frquency of and the condition for sustained oscillations for a BC phase shift. (9)

(*c*) A colpints oscillator is designed with capactor C_1 = 100pF and C_1 = 7500pF and a variable inductor. Determien the range of inductance, if the frequency of oscillations is to vary between 950kHz to 2050kHz. (5.75)

Q. 6. (*a*) Determine the value of the resistance R the given circuit if the gain of the circuit is 10.



(*b*) Derive an expression for frequency of oscillations and the condition for sustained oscillations for a Wien bridge oscillator using op-amp. In which frequency range it can be used. (8.75)

(*c*) Derive an expression for output of an ideal integrator. What are the limitations of ideal op-amp integrator? Give the circuit of practical integrator and explain how these limitations can be overcome. (5)

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