Q. No.		Marks
1)	(a) LOG amplifier: Circuit diagram (2M) Derivation for output (2M) Disadvantages. (1M)	
	(b) Comparison - 5 points - (5M) Block diagram, A_f, R_{inf}, R_{of}, β, definition.	
	(c) Full wave rectifier: Circuit diagram (2M) Working with input-output waveforms (3M)	
2)	(a) Colpitt's oscillator: Circuit diagram (2M) Derivation (5M) Disadvantage (1M) Solution to the disadvantage: (2M)	
	(b) $P_L = 9\,W$, $R_L = 6\,\Omega$, circuit (2M) Assume $\eta_T = 0.9$, $P_L' = \frac{P_L}{\eta_T}$ $P_{d(max)} \geq 2P_L'$, select ECN149 (1M) Select V_{CC} $\left(V_{CC} < \frac{V_{CEO}}{2}\right)$, $V_{RE} = 10\% \, V_{CC}$	(½M)
	$R_L' = \frac{(V_{CC} - V_{RE} - V_{CE(sat)})^2}{2P_L'} = \frac{V_{CEQ}^2}{2P_L'}$	(1M)
	$\frac{N_1}{N_2} = \sqrt{\frac{R_L'}{R_L}}$ (½M)	
	$I_{CQ} = \frac{2P_L'}{V_{CEQ}}$ $R_E = \frac{V_{RE}}{I_{EQ}}$	(1M)
	Assume $S \leq 10$, $S = \frac{(1+\beta_{max})(1+K)}{1+\beta_{max}+K}$	

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(1M)

$\therefore K = 9.89 = \frac{R_{th}}{R_E}$, $V_{th} = V_{BE} + I_C\left(\frac{R_{th}}{\beta_{typ}} + R_E + \frac{R_E}{\beta_{typ}}\right)$ (1M)

$R_1 = \frac{V_{CC} R_{th}}{V_{th}}$ $\qquad R_2 = \frac{V_{th} R_1}{V_{CC} - V_{th}}$ (1M)

Find P_{R_1} and P_{R_2} and select R_1, R_2. (1M)

Select $C_C = 10\,\mu F / V_{CC}$, $C_E = 100\,\mu F / V_{CC}$.

Redraw circuit with all components. (1M)

Any other design steps may be considered.

4. (a) Shortcomings of ideal integrator:

Can not be used at low frequency (1M)

Practical integrator: Circuit diagram (2M)

Derivation for gain (5M)

Frequency response (2M)

5. (a) Class-B push-pull power amplifier:

Circuit diagram (2M)

Derivation for efficiency and figure of merit (5M)

Advantages (1M)

Disadvantages (1M)

Output current waveform (1M)

(c) Clamper: Circuit diagram (2M)

working (2M)

input - output waveforms (1M)

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6. (a) Characteristics of -ve feedback : 5 points (5M)

~~(b)~~

(b) Class AB push-pull power amplifier : Circuit diagram (2M)
working (1M)
Input - output waveforms (1M)
Advantages (1M)

(c) Current mirror circuit (2M)
working (3M)

(d) Peak detector : Circuit (2M)
working (2M) Output waveform (1M)

(e) Schmitt trigger : Circuit (2M)
working with waveforms (3M)

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ECD - II

Solution

Numericals.

1) (d) P_D (without heat sink) $= \dfrac{T_{j\,max} - T_{amb}}{\theta_{dev\text{-}case} + \theta_{case\text{-}amb}}$

$= 1.86\ W$

P_D (with heat sink) $= \dfrac{T_{j\,max} - T_{amb}}{\theta_{dev\text{-}case} + \theta_{case\text{-}sink} + \theta_{sink\text{-}amb}}$

$= 16.1\ W$

3) (a) Designing of instrumentation amplifier (4 M)

$$A_f = \frac{R_3}{R_2}\left[1 + \frac{2R_f}{R_1}\right]$$

Let $\dfrac{R_3}{R_2} = \dfrac{1}{5}$

Case (i) $A_{f\,min} = 1$

$\therefore 1 + \dfrac{2R_f}{R_{1\,max}} = 2$

$\therefore R_{1\,max} = \dfrac{R_f}{2}$

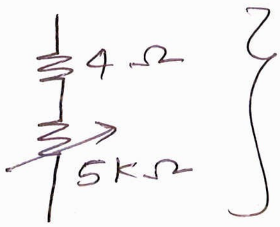
Case (ii) $A_{f\,max} = 1000$

$\therefore 1 + \dfrac{2R_f}{R_{1\,min}} = 5000$

$\therefore R_{1\,min} = \dfrac{2R_f}{4999}$

Let $R_f = 10\ k\Omega$ $\therefore R_{1\,min} = 4\Omega$, $R_{1\,max} = 5\ k\Omega$

Let R_1 be a combination of one fixed resistor (4Ω) in series with Variable resistor (5 kΩ)



R_1

Q. No. | Marks

3) (b) $I_{BQ} = \frac{V_{EE} - V_{BE}}{R_S + 2\beta R_E} = 43\ \mu A$ (1M)

$I_{EQ} = 6.5\ mA$ (½ M)

$r_e = 4\ \Omega$ (½ M)

Derivation - (4M)

$A_d = \frac{R_C}{2r_e} = 587.5$ (½ M)

$A_c = \frac{-R_C}{2R_E} = -1.6$ (½ M)

$CMRR = 20 \log_{10} \left| \frac{A_d}{A_c} \right| = 51.3\ dB$ (1M)

Need of swamping resistor (2M)

4) (b) Type: Voltage shunt negative feedback (1M)

circuit without feedback (2M)

$R_M = \frac{-h_{fe} R_S' R_C' (1+h_{fe}) R_E}{(R_E + h_{ie})(R_S' + h_{ie} + (1+h_{fe})(R_E \| h_{ie}))}$ (3M)

where $R_S' = R_S \| [R_f + (R_2 \| R_1)] = 990\ \Omega$

$R_C' = R_C \| [R_1 + (R_f \| R_2)] = 2.3\ k\Omega$

$\therefore R_M = -219.067\ k\Omega$ (1M)

~~R_{in}~~ $\beta = \frac{-R_2}{R_f(R_1 + R_2)} = 4.76 \times 10^{-7}\ \mho$ (2M)

$R_{in} = R_S' \| [h_{ie} + (1+h_{fe})(R_E \| h_{ie})]$
$= 971\ \Omega$ (2M)

$R_{Mf} = \frac{R_M}{1 + R_M \beta} = -198.38\ k\Omega$ (1M)

$R_{inf} = \frac{R_{in}}{1 + R_{in}\beta} = 879.5\ \Omega$ (1M)

Q. No. | Marks

5) (b) Designing of RC phase shift oscillator

Circuit diagram - (2M)

Designing (3 M)

$$f_{osc} = \frac{1}{2\pi RC\sqrt{6}}$$

Let $C = 0.01\ \mu F$

$\therefore R = 650\ \Omega$

$$\frac{R_f}{R} \geq 29$$

$\therefore R_f \geq 19\ k\Omega$

Select $R_f = 21\ k\Omega$.

—— x —— x ——