S.E.(Etrx) Sem 4 (Rev.)

273 : 2ndHf-I

Electronic Circuit Analysis & Design-II 10/12/07

Con. 5003-07. **(REVISED COURSE)** CD-5817.

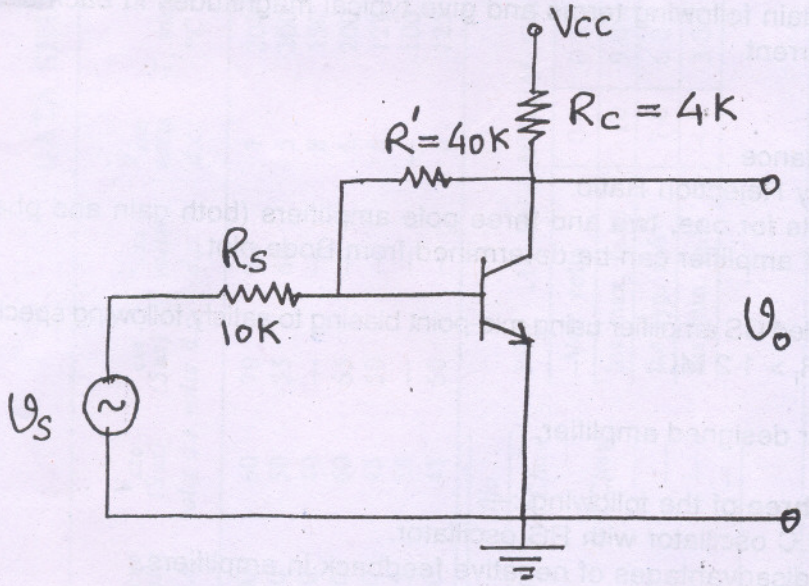
(3 Hours) **[Total Marks : 100**

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions from Question Nos. **2** to **7**.
(3) Assume **suitable** data wherever **necessary**.
(4) **Figures** to the **right** indicate **full** marks.

1. Attempt any **five** of the following :— **20**
   (a) State and prove Barkhuson's criteria for sustained oscillations.
   (b) Realise the following expression using practical OP-AMP :—
   $V_0 = 4V_3 - 2V_1 - 3V_2$.
   (c) Explain the use of swamping resistor in differential amplifier.
   (d) Explain the advantages of class AB power amplifier over class B power amplifier with suitable waveforms.
   (e) Which type of feedback will you use to obtain amplifier with stable transconductance ? Draw one circuit diagram of such an amplifier.
   (f) Write a short note on Cascade amplifier.

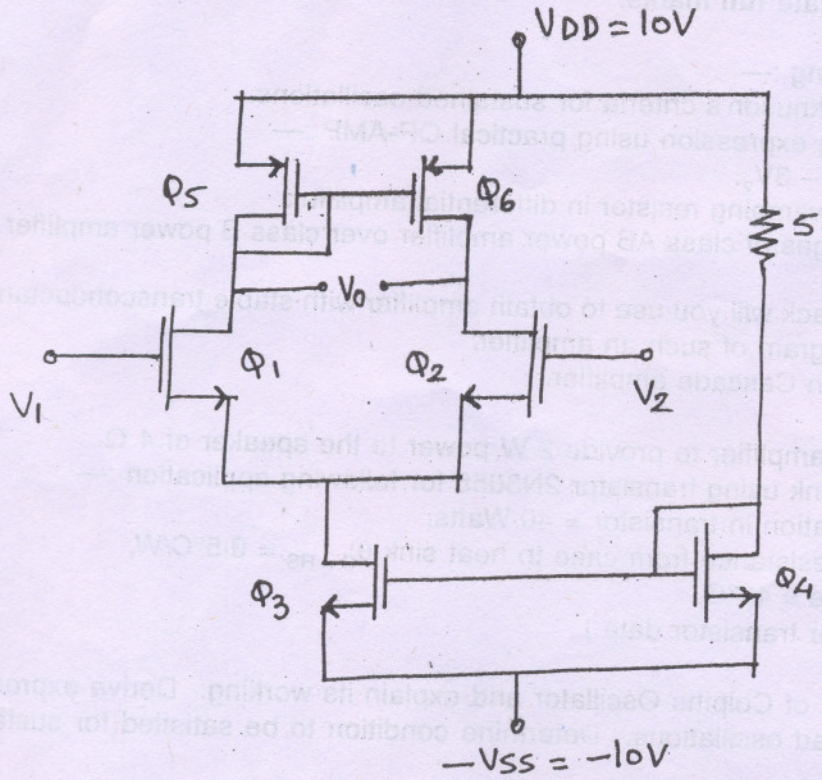
2. (a) Design a class A power amplifier to provide 2 W power to the speaker of 4 Ω. **12**
   (b) Design a suitable heat sink using transistor 2N3055 for following application :— **8**
   Actual power dissipation in transistor = 40 Watts,
   Maximum thermal resistance from case to heat sink θ_{C-HS} = 0·5°C/W,
   Ambient temperature = 40°C.
   (Refer data sheet for transistor data.)

3. (a) Draw the circuit diagram of Colpitts Oscillator and explain its working. Derive expression for frequency of sustained oscillations. Determine condition to be satisfied for sustained oscillations. **10**
   (b) For the circuit shown in **figure**, determine A_{vf}, R_{if} and R_{of}' using negative feedback approach. **10**



Assume —
h_{ie} = 1·1 KΩ,
h_{fe} = 50,
$h_{re} = h_{oe}$ = 0

4. Determine and derive expressions for differential mode gain, common mode gain and CMRR for the circuit shown in **figure**. Assume early voltage $|V_A| = 100$ V for n-MOSFET and $|V_A| = 50$ V for P-MOSFET, for calculations of drain resistance of a transistor. Find the Q point of main transistors Q_1 and Q_2 and draw the frequency response nature. **20**



$K_n = K_p = 312\ \mu A/V^2$

$|V_{TP}| = V_{Tn} = 3$ V

5. (a) For OP-AMP 741, explain following terms and give typical magnitudes in each case :— **10**
   - (i) Input bias current
   - (ii) CMRR
   - (iii) Slew rate
   - (iv) Output resistance
   - (v) Power Supply Rejection Ratio.

   (b) Draw typical Bode plots for one, two and three pole amplifiers (both gain and phase) and explain how stability of amplifier can be determined from Bode plot. **10**

6. Design a two stage RC coupled CS amplifier using mid-point biasing to satisfy following specifications. **20**
   $|A_V| \geq 15$, $V_o = 3$ V, $R_i > 1{\cdot}2$ MΩ.
   Use JFET BFW11.
   Determine A_V, R_i and R_o for designed amplifier.

7. Write short notes on any **three** of the following :— **20**
   - (a) Compression of LC oscillator with RC oscillator.
   - (b) Advantages and disadvantages of negative feedback in amplifiers.
   - (c) Nyquist stability criteria.
   - (d) Concept of virtual ground in OP-AMP.

DATA SHEET

Transistor type	Pdmax @ 25°C Watts	Icmax @ 25°C Amps	$V_{CE}^{(sat)}$ volts d.c.	V_{CBO} volts d.c.	V_{CEO} (Sus) volts d.c.	V_{CER} (Sus) volts d.c.	V_{CEX} volts d.c.	V_{BEO} volts d.c.	T_j max °C	D.C. current gain min	typ.	max.	Small Signal min.	typ.	h_{fe} max.	V_{BE} max.	θ_{fc} °C/W	Derate above 25°C W/°C
2N 3055	115·5	15·0	1·1	100	60	70	90	7	200	20	50	70	15	50	120	1·8	1·5	0·7
ECN 055	50·0	5·0	1·0	60	50	55	60	5	200	25	50	100	25	75	125	1·5	3·5	0·4
ECN 149	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
ECN 100	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	0·05
BC147A	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
2N 525(PNP)	0·225	0·5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
BC147B	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

Transistor type	hie	hoe	hre	θja
BC 147A	2·7 K Ω	18μ ℧	1·5 × 10^{-4}	0·4°C/mw
2N 525 (PNP)	1·4 K Ω	25μ ℧	3·2 × 10^{-4}	—
BC 147B	4·5 K Ω	30μ ℧	2 × 10^{-4}	0·4°C/mw
ECN 100	50 Ω	—	—	—
ECN 149	15 Ω	—	—	—
ECN 055	12 Ω	—	—	—
2N 3055	6 Ω	—	—	—

BFW 11—JFET MUTUAL CHARACTERISTICS

−VGS volts	0·0	0·2	0·4	0·6	0·8	1·0	1·2	1·6	2·0	2·4	2·5	3·0	3·5	4·0
IDS max. mA	10	9·0	8·3	7·6	6·8	6·1	5·4	4·2	3·1	2·2	2·0	1·1	0·5	0·0
IDS typ. mA	7·0	6·0	5·4	4·6	4·0	3·3	2·7	1·7	0·8	0·2	0·0	0·0	0·0	0·0
IDS min. mA	4·0	3·0	2·2	1·6	1·0	0·5	0·0	0·0	0·0	0·0	0·0	0·0	0·0	0·0

N-Channel *JFET*

Type	V_{DS} max. Volts	V_{DG} max. Volts	V_{GS} max. Volts	P_d max. @25°C	T_j max.	I_{DSS}	g_{mo} (typical)	$-V_P$ Volts	r_d	Derate above 25°C	θ_{ja}
2N3822	50	50	50	300 mW	175°C	2 mA	3000 μ ℧	6	50 KΩ	2 mW/°C	0·59°C/mW
BFW 11 (typical)	30	30	30	300 mW	200°C	7 mA	5600 μ ℧	2·5	50 KΩ	——	0·59° C/mW