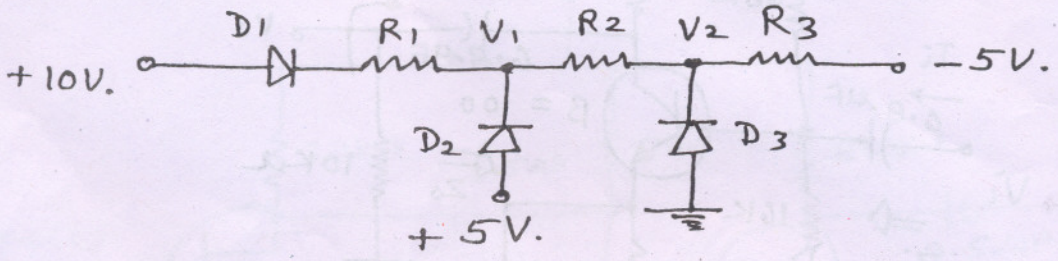
(3 Hours) **[Total Marks : 100**

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

1. Solve any **four** of the following :— **20**

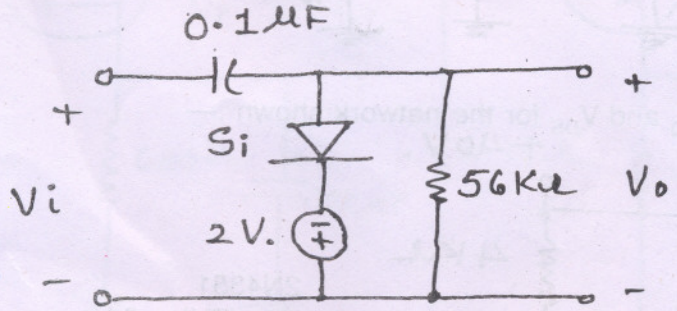
(a) n-channel, CS, JFET amplifier with self-biased circuit configuration with R_S bypassed is desired to bias for zero drain current drift. If R_D = 10 KΩ, V_P = –2·0 V, g_{mo} = 1·6 mA/V and I_{DSS} = 1·65 mA. Find —
(i) I_D for zero drift, (ii) V_{GS}, (iii) R_S, (iv) A_V.
Assume V_{DD} = 24 V.

(b) The cut-in voltage for each diode is 0·6 V. Determine V_1 and V_2 and each diode current if R_1 = 2 KΩ, R_2 = 6Ω, R_3 = 2 KΩ.



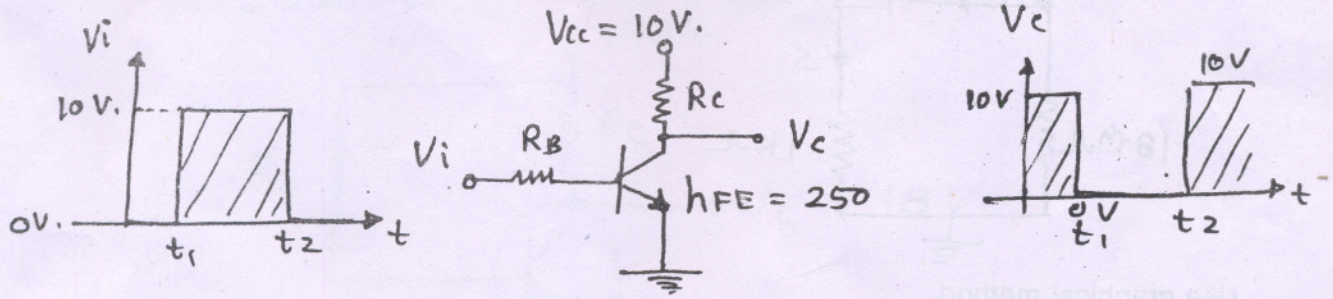
(c) Compare common base, common collector and common emitter BJT amplifiers.

(d)



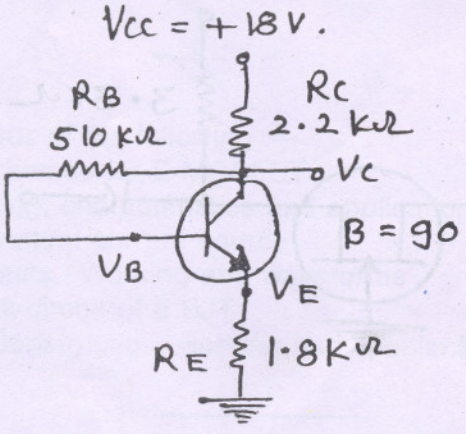
For the given network find 57 of the circuit, compare it with half the period of applied signal and sketch V_o if V_i is 20 V P–P, square wave, 1 kHz waveform.

(e) Determine R_B and R_C for the transister inverter if I_C sat = 10 mA.



(f) Compare 'L' and 'C' filter.

2. (a) Answer the following questions about the circuit shown :— **10**

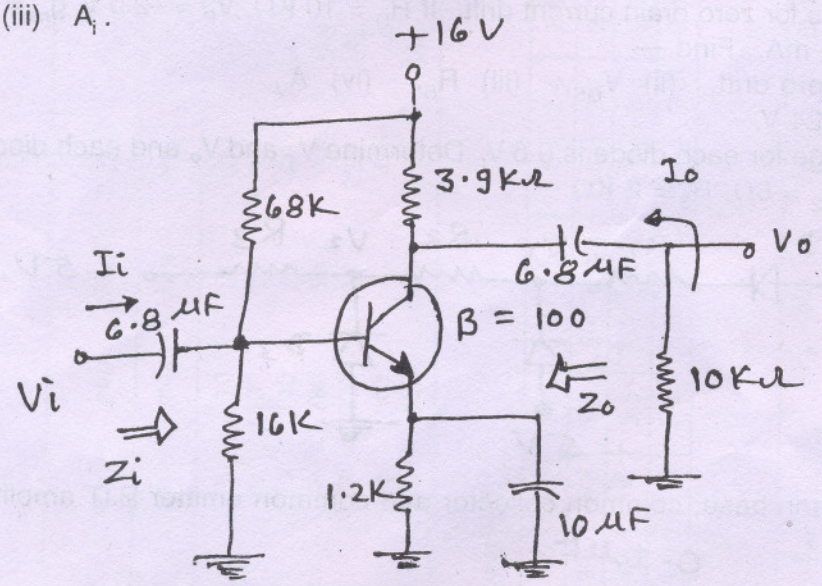


[TURN OVER

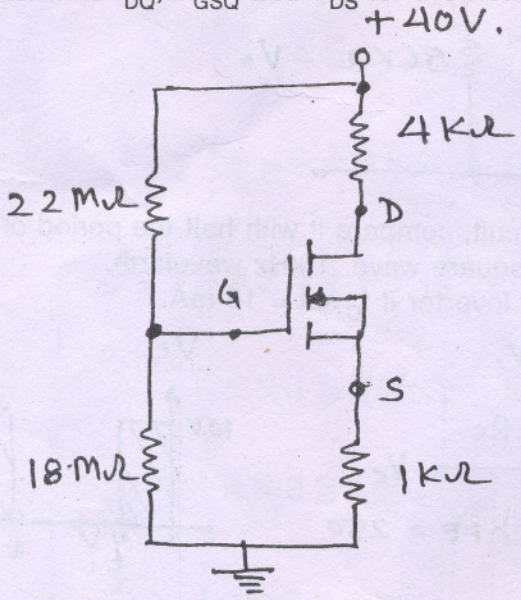
(i) What happens to the voltage V_C if resistor R_B is open.
(ii) What should happen to V_{CE} if B increases due to temperature.
(iii) How will V_E be affected when R_C is replaced with one whose resistance is at the lower end of the tolerance range ?
(iv) If transistor collector connection becomes open, what will happen to V_E ?
(v) What might cause V_{CE} to become nearly 18 V.

(b) For the given circuit find :— **10**

(i) Determine Z_i, Z_o and A_v no load
(ii) A_v with load
(iii) A_i .



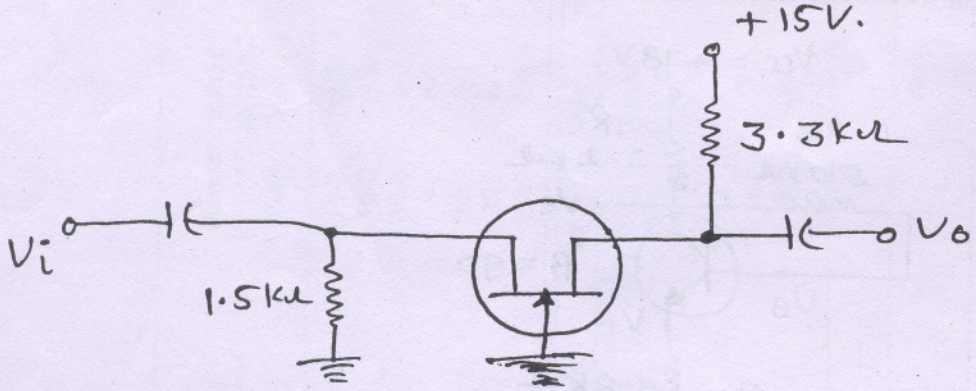
3. (a) Determine I_{DQ}, V_{GSQ} and V_{DS} for the network shown :— **10**



2N4351
V_{GS} (TH) = 5 V
I_D(on) = 3 mA
at V_{GS} (on) = 10 V.

Use graphical method.

(b) Determine Z_i, Z_o and V_o if V_i = 0·1 mV repeat the same if γ_d = 25 KΩ. **10**



I_{DSS} = 8 mA
V_p = −2·8 V
γ_d = 40 KΩ

4. Design a single stage CS JFET amplifier using Potential Divider Biasing for the following specifications :— **20**

$V_o = 2$ V, $f_L = 20$ Hz

$I_D = 3{\cdot}3 \pm 0{\cdot}6$ mA

$|A_v| = 11$

Use BFW11.

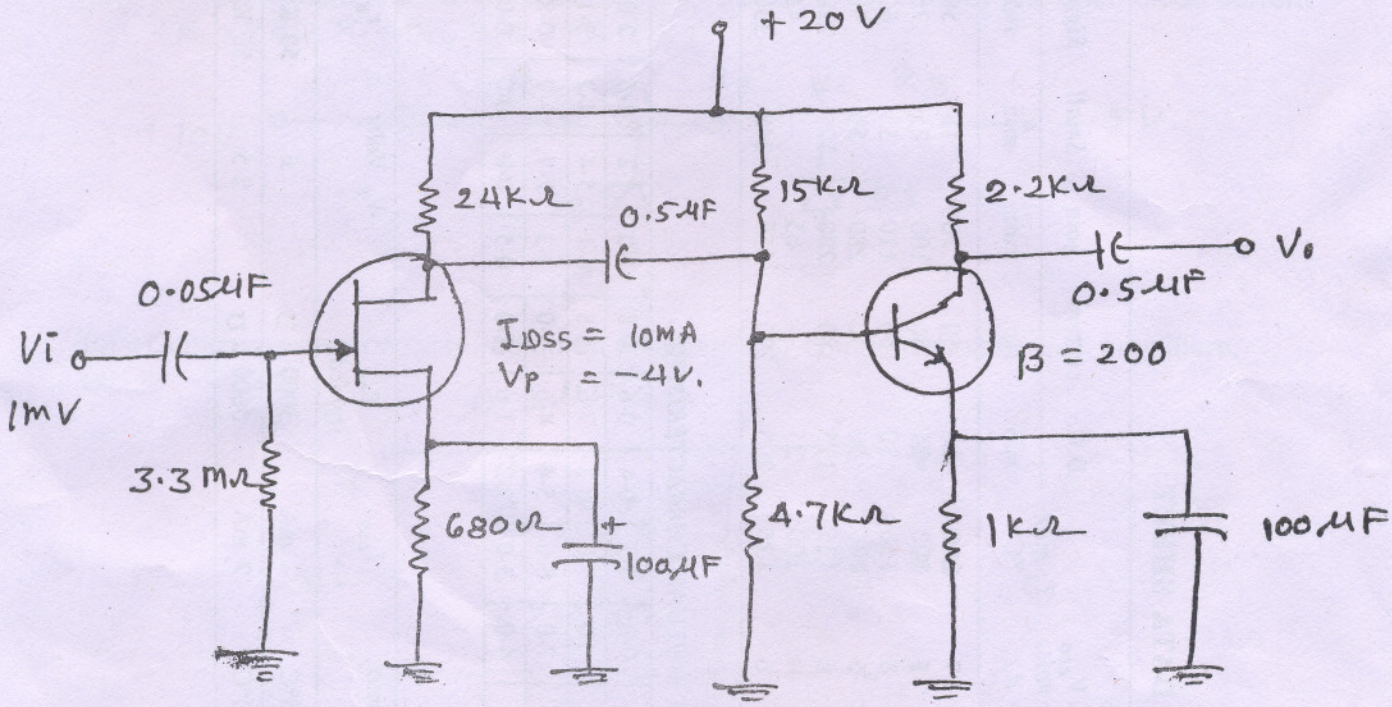
Calculate R_i, R_o and $V_{o\ (max.)}$ for the designed amplifier.

5. Design a single stage CE BJT amplifier using BC147A to satisfy the following specifications :— **20**

$|A_v| \geq 120$, $SI_{co} \leq 8$, $V_{cc} = 24$ V, $R_L = 10$ KΩ, $f_L > 10$ Hz, $I_{CQ} = 3$ mA.

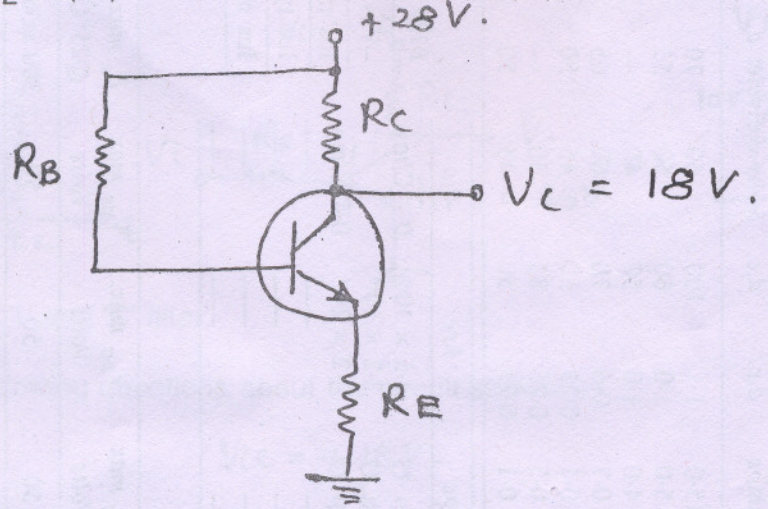
Estimate R_i and R_o of designed amplifier. If $R_i \geq 3$ KΩ is new specification then suggest suitable modifications in above design. What sacrifices you have made ? Calculate that.

6. (a) For the Cascade amplifier shown calculate input impedance, output impedance, voltage gain and resulting output voltage if $V_i = 1$ mV sine wave of 2 KHz. **14**



(b) Determine R_C, R_E and R_B if the specifications for the given circuit is — **6**

$I_{CQ} = \frac{1}{2} I_{C\ (sat.)}$, $V_{CC} = 28$ V, $V_C = 18$ V, $I_{C(sat)} = 8$ mA, $B = 110$.



7. Write short notes on any **four** of the following :— **20**

(a) Various biasing schemes for E-MOSFET

(b) Solar Cells : Working, characteristics and applications

(c) Transistor as a constant current source

(d) Diode clipping circuits : Working and waveforms

(e) Hybrid π equivalent circuit of a BJT

(f) Schottky Diode : Construction, working and special features, V-I characteristics.

DATA SHEET

sistor 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_{fe} °C/W	Derate above 25°C W/°C
055	115·5	15·0	1·1	100	60	70	90	7	200	20	50	70	15	50	120	1·8	1·5	0·7
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
149	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
100	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	0·05
47A	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
525(PNP)	0·225	0·5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
47B	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

sistor type	hie	hoe	hre	θja
147A	2·7 K Ω	18μ ℧	1·5 × 10⁻⁴	0·4°C/mw
525 (PNP)	1·4 K Ω	25μ ℧	3·2 × 10⁻⁴	—
147B	4·5 K Ω	30μ ℧	2 × 10⁻⁴	0·4°C/mw
V 100	50 Ω	—	——	——
V 149	15 Ω	—	——	——
V 055	12 Ω	—	——	——
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

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}
3822	50	50	50	300 mW	175°C	2 mA	3000 μ ℧	6	50 KΩ	2 mW/°C	0·59°C/mW
W 11 (typical)	30	30	30	300 mW	200°C	7 mA	5600 μ ℧	2·5	50 KΩ	——	0·59° C/mW

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_{jc} °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