Time: 3 Hours **Marks: 80**

N.B. : (1) Question No. 1 is compulsory.

(2) Solve any three questions from the remaining five

(3) Figures to the right indicate full marks

(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt any 5 questions **[20]**

a) Prove that for a JFET the gate-source bias for zero temperature drift of drain current is at $|V_P| - 0.63$ volts.

b) Explain the hybrid pi model of BJT.

c) Explain Zener as voltage regulator.

d) Consider a BJT has parameters f_T =500MHz at I_C = 1mA, β = 100 and $C\mu$ = 0.3pF. Calculate bandwidth of f_β and capacitance $C\pi$ of a BJT.

e) Draw and explain small signal model of a diode.

f) Why should R_C be as large as possible in the design of CE amplifier?

Q.2 a) Design a voltage divider bias network using a supply of 24 V, a transistor with β=110 and an operating point of I_{CQ} = 4 mA and V_{CEQ} = 8V. Assume $V_E = \frac{1}{8}V_{CC}$. **[10]**

b) Explain the fabrication steps of passive elements. **[5]**

c) What are the important JFET parameters and define it from characteristics. **[5]**

Q.3 a) Design the resistors of a single stage CS amplifier for audio frequency with BFW11 with $I_{DS} = (3.3 \pm 0.6)$ mA and $|A_V| = 12$. **[10]**

b) Draw CS JFET amplifier with self bias circuit and derive the expression for voltage gain input impedance and output impedance. **[10]**

Q.4 a) Draw small signal hybrid parameter equivalent circuit for CE amplifier and define the same. What are the advantages of h parameters? **[10]**

b) For the circuit shown below in Fig.4b, the transistor parameters are V_{BE} $_{(on)}$ = 0.7 V, β = 200 and $V_A = \infty$. **[10]**

i) Derive the expression for lower cut-off frequency (or time constant) due to input coupling capacitor.

ii) Determine lower cut-off frequency and midband voltage gain.

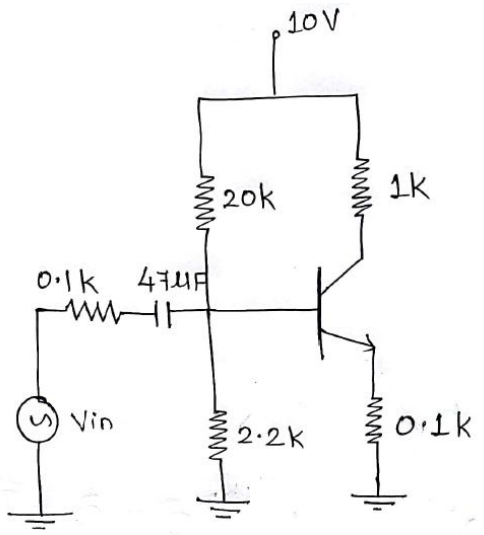

Fig.4b

Q.5 a) Design an L section LC filter with full wave rectifier to meet the following specifications: The DC output voltage $V_{DC} = 220$ V, deliver $I_L = (70 \pm 20)$ mA to the resistive load and the required ripple factor is 0.04. **[10]**

b) For the circuit shown below in Fig.5b, the transistor parameters are $V_{BE(on)} = 0.7$ V, $\beta = 100$ and $V_A = \infty$. Determine Z_i, Z_o and A_V **[10]**

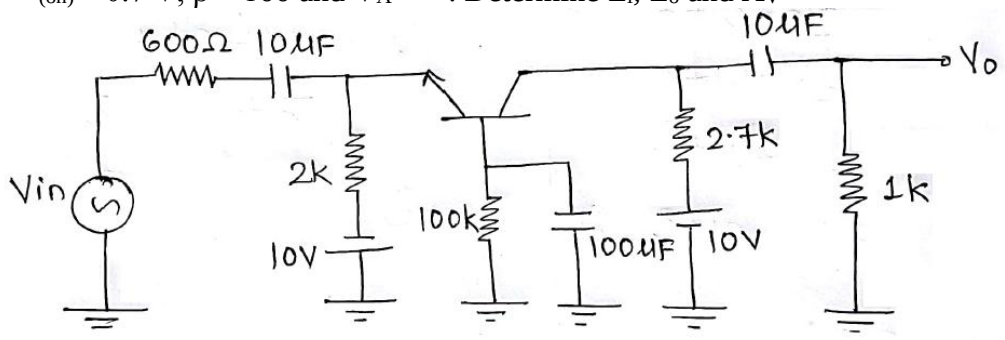

Fig. 5b

Q.6 Short notes on: (Attempt any four) **[20]**

a) BJT high frequency equivalent circuit
b) Types of resistors and capacitors
c) Stability factors of various biasing techniques of BJT
d) Different types of filters
e) Comparison of BJT CE and JFET CS amplifier

Transistor type	$P_{d}max$ @ 25°C Watts	$I_{c}max$ @ 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_{EBO} volts d.c.	T_j max °C	D.C. current gain min	D.C. current gain typ.	D.C. current gain max.	Small Signal h_{fe} min.	Small Signal h_{fe} typ.	Small Signal h_{fe} max.	V_{BE} max.	θ_{j-c} °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	0·03
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 ℧	$1·5 \times 10^{-4}$	0·4°C/mw
2N 525 (PNP)	1·4 K Ω	25μ ℧	$3·2 \times 10^{-4}$	—
BC 147B	4·5 K Ω	30μ ℧	2×10^{-4}	0·4°C/mw
ECN 100	500 Ω	—	—	—
ECN 149	250 Ω	—	—	—
ECN 055	100 Ω	—	—	—
2N 3055	25 Ω	—	—	—

BFW 11—JFET MUTUAL CHARACTERISTICS

$-V_{GS}$ 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
I_{DS} 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
I_{DS} 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
I_{DS} 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_{j-a}
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