Q. P. Code: 36418

Time: 3 hours Total Marks: 80

Note: 1) Question No.1 is compulsory.

2) Attempt any three questions from remaining five questions.

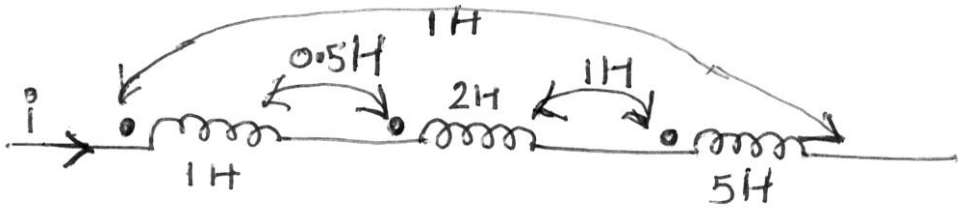
3) Figures to the right indicate full marks.

4) Use Smith Chart for transmission line problem.

Q.1) Solve the following questions.

a) Test for Hurwitz polynomial using continued fraction expansion method. 5M
$P(s)= S^4+7S^3+6S^2+21S+8$

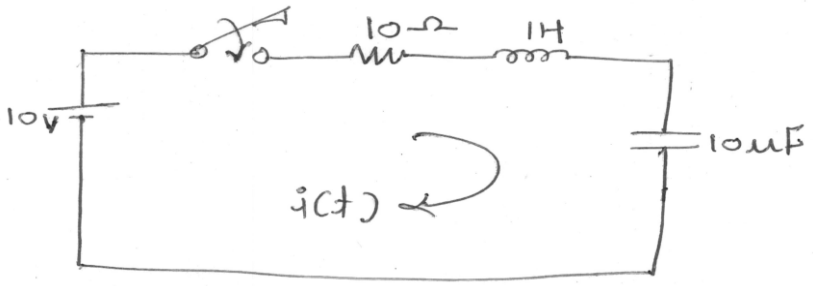
b) Find the equivalent inductance of the network shown 5M



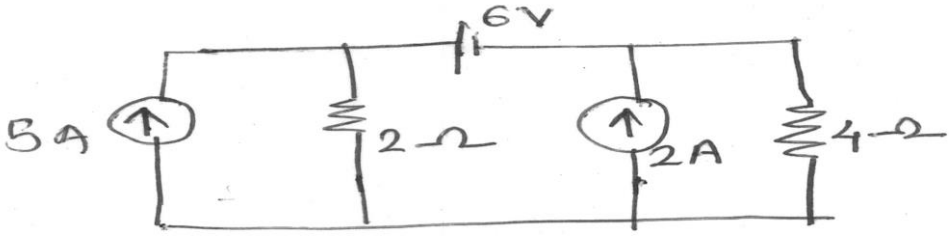
c) Explain the various types of filters. 5M

d) Find ABCD parameters in terms of Z parameters. 5M

Q.2) a) In the network shown the switch is changed from the position 1 to the position 2 at t=0. Steady condition having reached before switching. Find the values i, di/dt and d^2i/dt^2 at $t=0^+$. 8M

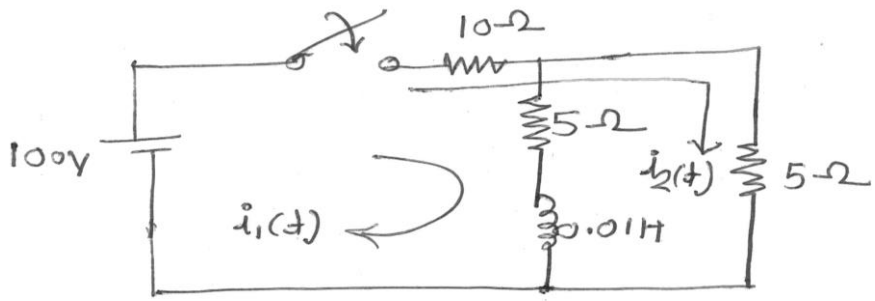


b) Find the current in the 4 Ω resistor shown in the network. Use source transformation. 8M

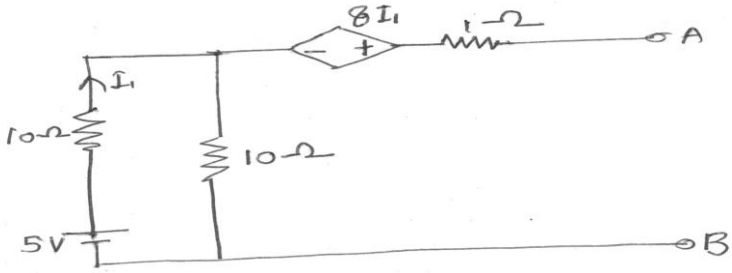


c) A coil of 20 Ω resistance has an inductance of 0.2 H and connected in parallel with a condenser of 100 μF Capacitance. Calculate the frequency at which this circuit will have as a non –inductive resistance. Find also the value of dynamic resistance. 4M

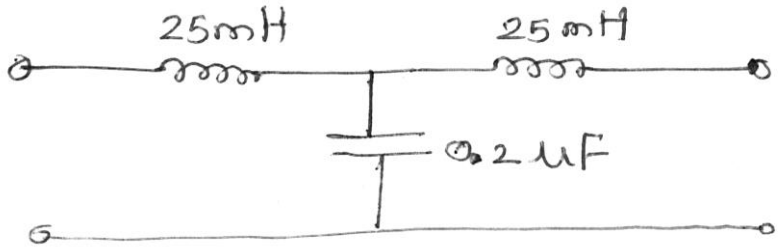
Q.3) a) In the network shown determine the currents i1 (t) and i_2 (t) when the switch is closed at t=0. 8M



b) Find the Thevenin's equivalent of following network. 8M



c) Find the nominal impedance, cut off frequency and pass band for the network shown. 4M



Q.4) a) 10M

Determine the foster forms of realization of the RC impedance function.

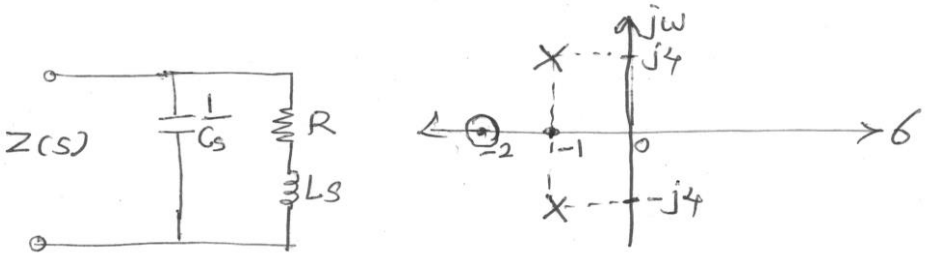
$$Z(s)= \frac{2(s+2)(s+4)}{(s+1)(s+3)}$$

b) Test for positive real function 10M

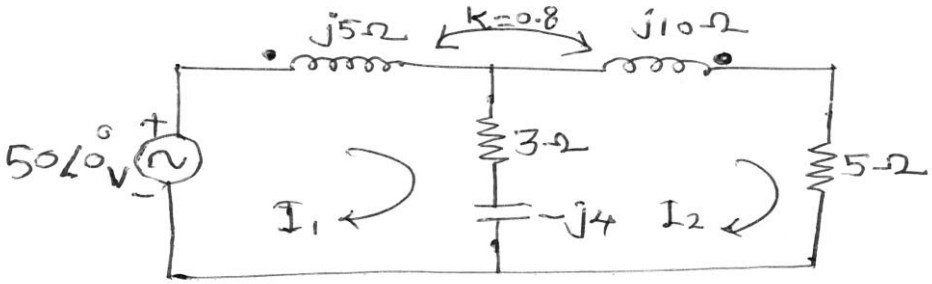
i) $$F(s)= \frac{3(s+3)(s+5)}{(s+1)(s+4)}$$

ii) $$F(s)= \frac{s^3+6s^2+7s+3}{s^2+2s+1}$$

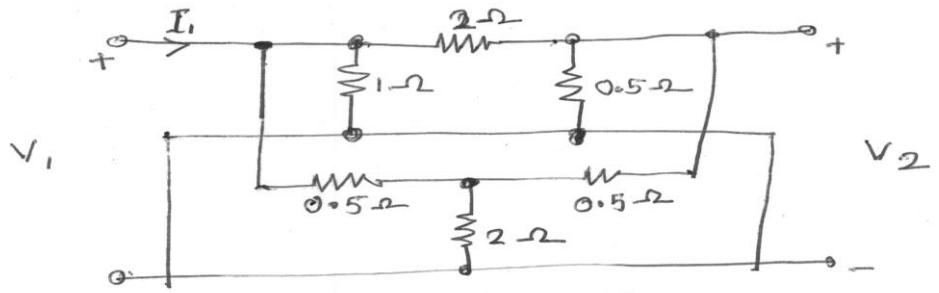
Q.5) a) The pole zero diagram of the driving point impedance function of the network is shown below. At dc, the input impedance is resistive and equal to 2W. Determine the values of R, L and C. 10M



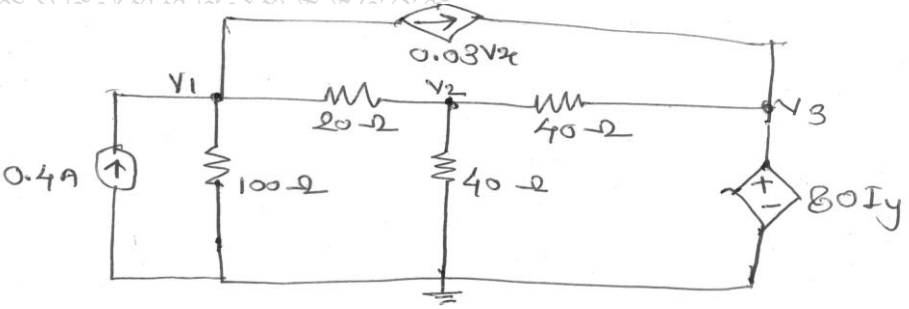
b) Find the voltage across 5Ω resistor in the network shown below. K=0.8 coefficient of coupling. 10M



Q.6) a) Find Y parameters for the given network. 10M



b) For the shown network find V_1 and V_2. 10M



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Q. P. Code: 38406

Time:3 hours Total marks: 80

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

(2) Answer any three questions from remaining .

(3) Figures to the right indicate full marks.

Q1. .

a) Evaluate $\int_0^{\infty} \frac{\sin 3t + \sin 2t}{te^t} dt$ 05

b) Find the directional derivative of the function $\phi = 4xz^2 + x^2yz$ at (1,-2,-1) in the direction of $2\hat{i} - \hat{j} - 2\hat{k}$. 05

c) Expand $f(x) = \pi x - x^2$ in a half range sine series in the interval (0,π) 05

d) Show that the function $u(x, y) = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ is harmonic. Find the corresponding analytic function f(z). 05

Q2.

a) Prove that $J_{\frac{3}{2}}(x) = \sqrt{\frac{2}{\pi x}}\left[\frac{\sin x}{x} - \cos x\right]$ 06

b) Find Fourier series to represent $f(x) = 4 - x^2$ in the interval (0,2). 06

c) Solve the following differential equation using Laplace transform $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 3te^{-t}$, given y(0)=4,y'(0)=2. 08

Q3.

a) Show that $\bar{F} = (y^2 - z^2 + 3yz - 2x)\hat{i} + (3xz + 2xy)\hat{j} + (3xy - 2xz + 2z)\hat{k}$ is conservative. Find the scalar potential for $\bar{F}$ and also find the work done by $\bar{F}$ in moving a particle from(1,0,1) to (2,1,3) 06

b) Obtain the complex form of the Fourier series for $f(x) = e^{3x}$ in (0,3) 06

c) Find the Inverse Laplace Transform of 08

i) $\frac{8s + 20}{s^2 - 12s + 32}$ ii) $\tan^{-1}\left(\frac{s + a}{b}\right)$

Q.4 a) Prove that $\int J_3(x)dx + 2\frac{J_1(x)}{x} + J_2(x) = 0$ 06

b) Evaluate $\int_C (x^2 ydx + x^2 dy)$ where C is the boundary described in the anti clockwise direction of the triangle with vertices (0,0),(1,0) and (1,1). 06

c) Find Fourier series expansion of 08

f(x) = 2 $-2 < x < 0$

= x $0 < x < 2$

Q5. a) Show that the map of the real axis of the z plane is a circle under the transformation $w = \frac{2}{z+i}$ .Find the centre and radius of the circle. 06

b) Find the Fourier Integral representation of 06

$f(x) = 1 \quad |x| < 1$

$= 0 \quad |x| > 1$ hence evaluate $\int_0^\infty \frac{\sin\omega \cos\omega x}{\omega} d\omega$

c) i) Find the Laplace Transform of 04

$(1 + 2t - t^2 + t^3) H(t-4)$

ii) If $\bar{F} = x^2 z\hat{i} - 2y^3 z^3 \hat{j} + xy^2 z^2 \hat{k}$, find div $\bar{F}$ and curl $\bar{F}$ 04

Q6. a) Use Convolution theorem to find $L^{-1}\left\{\frac{s^2}{(s^2+4)^2}\right\}$ 06

b)Use Gauss Divergence Theorem to evaluate $\iint_S \bar{N}.\bar{F} ds$ where $\bar{F} = 4x\hat{i} + 3y\hat{j} - 2z\hat{k}$ and S is the surface bounded by x=0,y=0,z=0 and 2x+2y+z=4. 06

c) If $f(z) = u + iv$ is an analytic function of $z = x + iy$ and $u + v = \cos x \cosh y - \sin x \sinh y$ find $f(z)$ in terms of z 08

(Time: 3 Hours) **[Total Marks: 80]**

N.B. : (1) Question No. 1 is **Compulsory**.
(2) Attempt any **three** questions out of **remaining five**.
(3) Each question carries 20 marks and sub-question carry equal marks.
(4) Assume suitable data if required.

Q1. a) Design and implement full subtractor using logic gates. (5)
b) Explain the working of a two –inputs CMOS NOR gate with a neat Diagram. (5)
c) Design a circuit using 2:1 MUX to implement 2 Input NAND Gate. (5)
d) Evaluate following operation in BCD. (5)
(i) $(56)_{10} + (23)_{10}$ (ii) $(48)_{10} + (26)_{10}$

Q2.a) Convert $(27)_{10}$ & $(42)_{10}$ into binary, octal , Hexadecimal , Excess-3 code and Gray code. (10)

b) Draw a neat circuit diagram of four bit Twisted ring counter with initial state 0000 and relevant output waveforms. (10)

Q3.a) Design a combinational logic circuit with four input variables that will produce logic 1 output when input is greater than 9. (10)

b) Draw a circuit diagram of clocked J-K flip –flop using NAND gates with truth table. What is race around condition and how does it get eliminated ? (10)

Q4.a) Simplify the expression in POS form for given function and realize it with basic gates.
$F(A,B,C,D)=\sum m\,(0,4,6,7,10,12,14)+ d\,(2,13)$ (10)

b) Convert the followings (10)
i) SR flip flop to JK flip flop. ii) JK flip-flop to D flip-flop

Q5 a) Implement the following expression using a single 8:1 multiplexer. (10)
$F(A,B,C,D) = \sum m\,(0,2,4,6,8,10,12,14)$

b) Simplify the following four variable Boolean function using Quine-Mccluskey technique.
$F(A, B,C,D) = \sum m\,(0, 2, 3,6,7,8,10,12,13)$ (10)

Q6.a) Design a Mod-5 synchronous up counter using T flip-flop. Design using minimal cost approach. (10)

b) Explain interfacing of a TTL gate driving CMOS gates and vice versa. (10)

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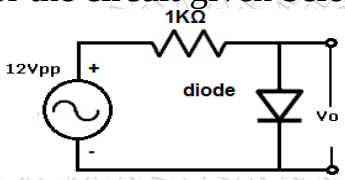
(3 hrs.) Maximum Marks = 80

Q1. is compulsory.
Attempt any **three** question from **Q.2 to Q.6.**
Assume suitable data if necessary.

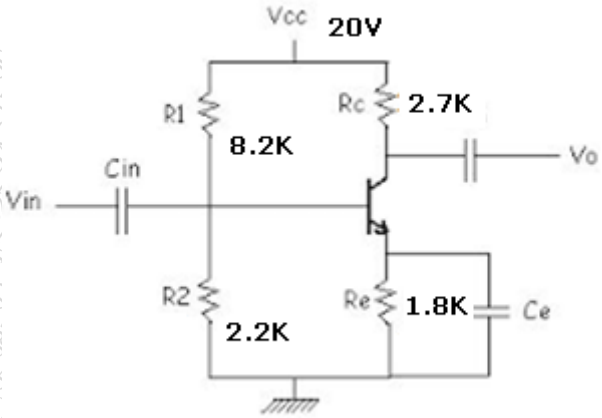
Q.1 Write any **four**. **20**

a) Explain working of pn junction diode and its V-I characteristics.
b) What is early effect in BJT?
c) Explain Zener diode as a voltage regulator.
d) Write short note on Tunnel diode.
e) Draw output waveform for the circuit given below



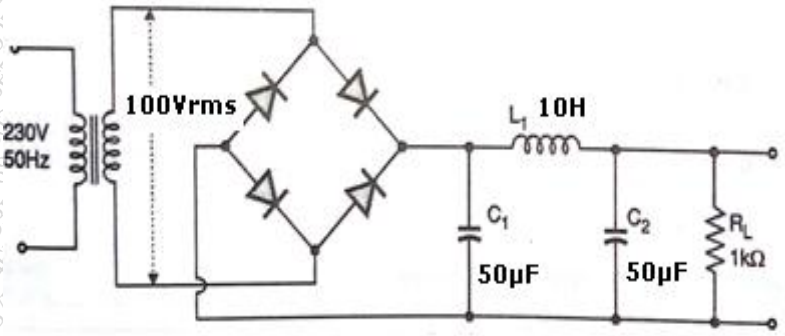
Q.2

a) Explain construction and working of solar cell and LED. **10**
b) Find Q point if β=120. Also draw dc load line. **10**



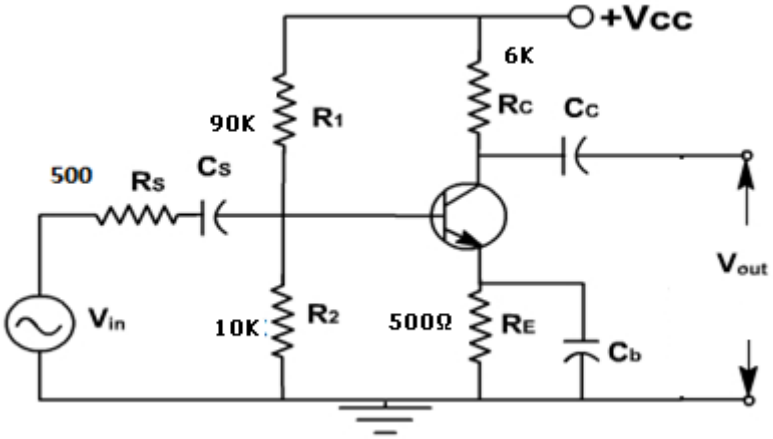
Q.3

a) Explain with construction working and characteristic operation of n-channel D-MOSFET. Also compare it with E-MOSFET. **10**
b) Calculate dc load voltage, an ac ripple in output and ripple factor. **10**



Q.4

a) Find Zi, Zo, A_V and A_{vs} using Hybrid-∏ model (V_{BE}=0.7V, β=100) **10**



b) Explain working of Full wave rectifier with LC filter. Also draw output waveforms and derive expression for ripple factor. **10**

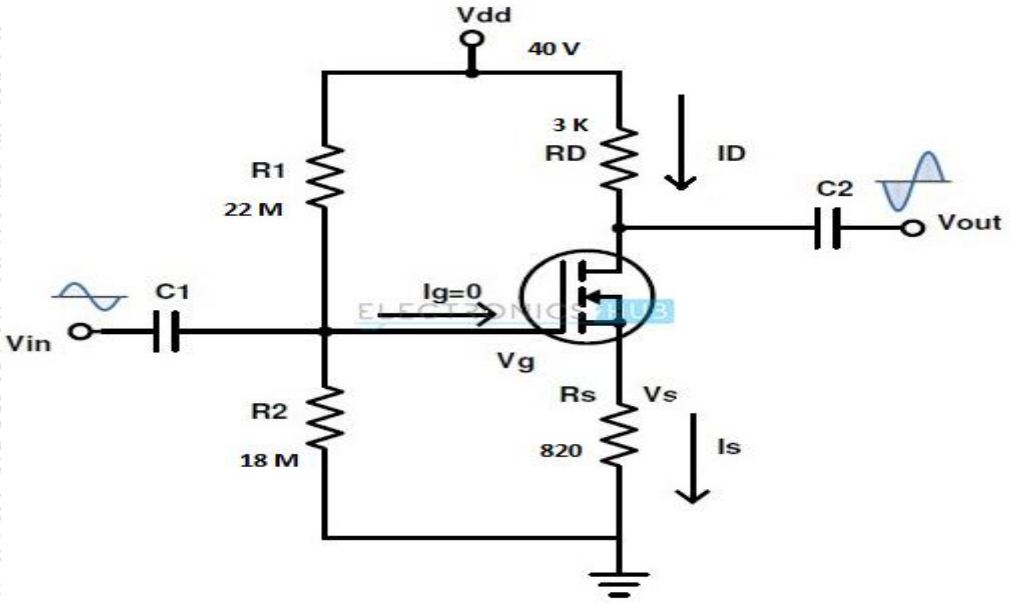
Q.5

a) Design single stage CE amplifier for $A_V \geq 180$, h_{fe} =220, V_{CC} = 18 V, h_{ie} = 2.7 K, $S_{ICO} \leq 10$, $f_L \leq 20$Hz $V_{CE\ sat}$ = 1V , V_{BE}= 0.7 V. h_{re} =h_{oe} = 0 **15**

b) Explain positive and negative clampers. **05**

Q.6

a) Find I_{DQ}, V_{DSQ} and V_{GSQ} if VGS_{TH} =5 V, $I_{D\ ON}$ =3mA and $V_{GS\ ON}$ = 10 V **10**



b) Compare CE, CB and CC configuration of BJT amplifier. **10**

DBEC 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_{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_{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_{m0} (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

Time:- 03 Hours **Max. Marks:- 80 Marks**

(i) Question No. 1 is compulsory & attempt any three out of the remaining five questions.
(ii) Assume suitable data if required but justify it logically wherever applicable.
(iii) Figures to the right indicate full marks & every sub-question from Q.2 to Q.6 has equal weightage.

Q.1 ATTEMPT ANY FOUR (04) :-

(a) Define the following dynamic characteristics of instruments & mention for which types of measurements they have to be considered?
(i) Speed of Response
(ii) Lag
(iii) Fidelity
(iv) Dynamic Error **20**
(b) Draw a neat circuit diagram of LCR – Q meter & explain its operating principle.
(c) Explain the function of delay line in cathode ray oscilloscope (CRO) with neat diagram.
(d) Describe operating principle of heterodyne wave analyzer with a neat block diagram.
(e) With a neat diagram, explain the principle of digital time measurement.
(f) Describe in brief, the classification / types of transducers.

Q.2 (a) The true value of the voltage across a resistor in a circuit is 10 V when it is calculated by mathematical analysis. Measuring the same voltage by six different random individuals (but all with the same digital multimeter) gives the following results as shown :- **20**

Observation No.	Measured Values
1	10.25 V
2	10.05 V
3	9.9 V
4	9.95 V
5	10.15 V
6	9.85 V

(i) Calculate the percentage error for the fourth observation.

(ii) Calculate the accuracy for the second observation.

(iii) Determine the precision of the fifth observation.

(iv) Calculate the standard deviation (σ) for the above observations.

(v) Calculate the average deviation (d_{avg}) for the above observations.

(b) Draw a neat labeled circuit diagram of Wien Bridge & derive the mathematical expression for the unknown AC source frequency.

Q.3 (a) Explain the basic cathode ray oscilloscope (CRO) with neat labeled block diagram & describe all its individual sections briefly.

(b) Explain how Lissajous patterns / figures are used for measurement of an unknown frequency & phase shift using a cathode ray oscilloscope (CRO) with neat labeled diagrams. **20**

Q.4 (a) With neat labeled block diagram, describe the construction & operation of a ramp type digital voltmeter (DVM) with appropriate waveforms.

(b) With neat labeled block diagram, describe the spectrum analyzer construction & operation. **20**

Q.5 (a) Write a short note on the linear variable differential transformer (LVDT) with reference to its construction, operation / working & characteristics while mentioning its applications.

(b) Explain the ultrasonic level measurement transducer with a neat block diagram with respect to construction & operation. **20**

Q.6 (a) Describe the rotameter transducer for the measurement of flow with a neat diagram. What are its advantages & disadvantages ?

(b) How are thermistors (thermally sensitive resistors) different from the resistance temperature detectors (RTD) although both of them use same operating principle of converting temperature variations (ΔT) into resistance variations (ΔR) ? Describe construction, operation, characteristics & applications of thermistors with neat sketch wherever necessary. **20**

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