[3 Hours]                                                    [Total Marks :-80]

**N.B:**  **(1) Question No.1 is compulsory.**
**(2) Solves any three out of remaining question.**
**(3) Assume suitable data if necessary.**

1.  **Any four**
    a  Draw characteristics of PN junction in thermal equilibrium and explain.                    **5**
    b. Explain the operation of MOSFET as amplifier.                                               **5**
    c. Explain construction, working principle and characteristics of Photodiode.                 **5**
    d. Compare HWR, FWR and Bridge rectifier.                                                      **5**
    e. Compare Zener and avalanche breakdown                                                       **5**
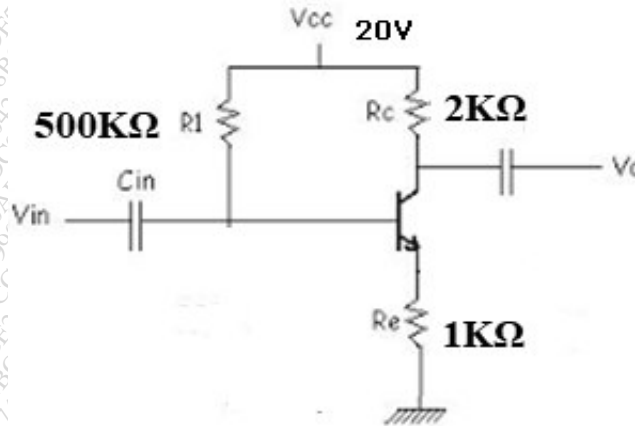
2.
a. Draw and explain positive and negative clamper circuit.                                        **10.**
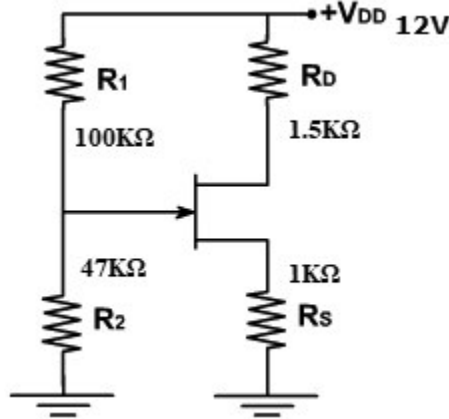b. Calculate dc load voltage, an ac ripple in output and ripple factor                            **10**
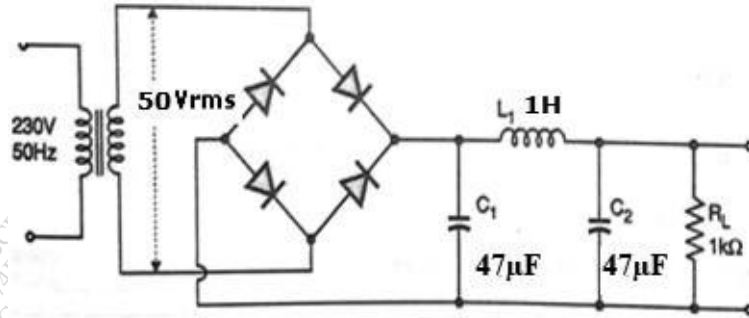


3.
a.  Draw and explain VI and CV characteristics of p-channel Enhancement type MOSFET.             **10**
b. Find $I_B$, $I_C$, $V_C$, $V_E$, and $V_{CE}$ for following circuit ($\beta=100$).             **10**

8B9F53D3223144C74BCE2CC990ADC042

**4**

a. Find $V_{GSQ}$, $I_{DQ}$, and $V_{DSQ}$ for following circuit.   (VP= -4V, IDSS= 6mA)   **10**
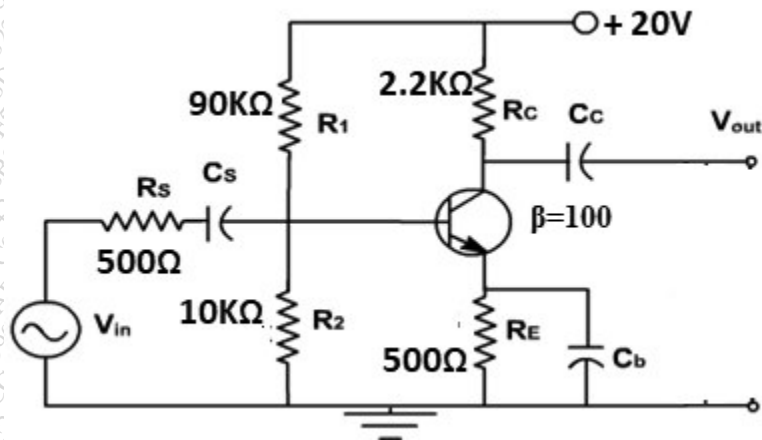


b. Compare CE,CB and CC amplifiers   **10**

**5.**

a. Design single stage CE amplifier for $A_V \geq 110$, $V_O$rms= 3 V, $h_{FE}$ =180, $h_{fe}$=220
   $h_{ie}$ = 2.7 KΩ, S≤10, $f_L$≤ 15Hz   $V_{CE\ sat}$ = 0.25V, $V_{BE}$= 0.7 V.   **15**

b) Compare D-MOSFET and E-MOSFET.   **05**

**6**

a. Find Zi, Zo, Av and Avs for following circuit.   **10**



b) Compare capacitor, inductor, LC and π filter.   **10**

_____

## DBEC DATA SHEET

| Transistor type | Pd max @25°C Watts | Ic max @25°C Amps | V_ce(sat) volts d.c. | V_cbo volts d.c. | V_cbo (Sus) volts d.c. | V_ceo (Sus) volts d.c. | V_ceo volts d.c. | V_ebo volts d.c. | T_j max °C | D.C. current gain min | typ | max | Small Signal min | typ | max | V_ss max | θ °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 KΩ | 18μ ℧ | $1·5 \times 10^{-4}$ | 0·4°C/mw |
| 2N 525 (PNP) | 1·4 KΩ | 25μ ℧ | $3·2 \times 10^{-4}$ | — |
| BC 147B | 4·5 KΩ | 30μ ℧ | $2 \times 10^{-4}$ | 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

| -V_gs volts | 0·0 | 0·4 | 0·6 | 0·8 | 1·0 | 1·2 | 1·6 | 2·0 | 2·4 | 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 | 2·0 | 1·1 | 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 |
| I_ds min. mA | 4·0 | 3·3 | 2·7 | 2·2 | 1·7 | 1·0 | 0·6 | 0·5 | 0·2 | 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_m (typical) | r_d | -V_p Volts | Derate above 25°C | θ_ja |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N3822 | 50 | 50 | 50 | 300 mW | 175°C | 2 mA | 3000 μ℧ | 50 KΩ | 6 | 2 mW/°C | 0·59°C/mW |
| BFW 11 (typical) | 30 | 30 | 30 | 300 mW | 200°C | 7 mA | 5600 μ℧ | 50 KΩ | 2·5 | — | 0·59° C/mW |

**DURATION : 3 HOURS**  **MAX.MARKS:80**

1) Question No.1 is compulsory
2) Attempt any THREE of the remaining
3) Figures to the right indicate full marks.

**Q1**  5

A) Find Laplace transform of $f(t) = \sin^5 t$

B) Prove that $u = x^2 - y^2$ is harmonic function also find corresponding analytic  5
function f(z)

C) Find the half range sine series of $f(x) = 2x$ in $(0 , \pi)$  5

D) Find the Unit normal vector to the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at  5
(2,-1,2) hence find angle between them

**Q2**

A) Prove that $J_{(-3/2)}(x) = -\sqrt{\frac{2}{\pi x}} .(\frac{\cos x}{x} + \sin x)$  6

B) Find the Bilinear transformation which maps the points $z = 1 , i , -1$ onto the  6
points $w = 0 , 1, \infty$

C) Obtain the fourier series for $f(x) = x\cos x$ in $(-\pi , \pi)$  8

**Q3**

A) Find inverse laplace transform of  6

(i) $\log(\frac{1+s^2}{4+s^2})$  (ii) $\frac{s+5}{(s+4)^3}$

B) Show that the of functions $\{\cos x ,\cos 3x , \cos 5x ,................\}$ is an orthogonal  6
over $[0 , \pi/2]$ .Hence construct orthonormal set of functions.

C) Prove that $y = \sqrt{x} .J_n(x)$ is a solution of the equation ,  8

$x^2 \frac{d^2 y}{dx^2} + (x^2 - n^2 + \frac{1}{4})y = 0$

**Q4**

A) Prove that $\int x^4 J_1(x)dx = x^4 J_2(x) - 2x^3 J_3(x)$     6

B) Use Gauss's Divergence theorem to evaluate $\iint_S \bar{N}.\bar{F}ds$ where $\bar{F}=4xi +3yj$     6
-2zk and S is the surface bounded by x=0 ,y=0 ,z= 0 and 2x +2y +z=4

C) Solve using Laplace transform( $D^2$ +2D+1)y =3te$^{-t}$ ,given y(0)=4 and     8
y'(0)=2

**Q5**

A Find Fourier series for     6

$$f(x)= \begin{cases} \pi + x , & 0 < x < \pi \\ \pi - x , & -\pi < x < 0 \end{cases}$$

B) Find the image of the region bounded by x+y=0 , x=y , x+y=1 ,x-y=1 under     6
the bilinear transformation w = 2z +2i

c) Prove that $\bar{F}=(y^2cosx + z^3)i+(2ysinx-4)j+(3xz^2+2)k$ is a conservative field     8
.Find (i)Scalar Potential for $\bar{F}$ (ii) The work done in moving an object in
this field from (0 ,1,-1) to($\frac{\pi}{2}$ , -1 ,2).

**Q6**

A) Find the Laplace Transform of e$^{-t}\int_0^t sin3ucos2udu$     6

B) Find Complex form of Fourier Series of sinh2x in (-2 , 2)     6

C) Express the function     8

$$f(x) = \begin{cases} 1 , & |x| < 1 \\ 0 , & |x| > 1 \end{cases}$$ as Fourier integral .Hence evaluate

$$\int_0^\infty \frac{sinw.coswx}{w} dw$$

\*\*\*\*\*\*\*\*\*\*\*\*

**(3 Hours)**                                                              **Total Marks: 80**

N.B:  (1) Question **No. 1** is compulsory.
      (2) Attempt any **three questions** from the remaining.
      (3) Figures to the right indicate full marks.
      (4)Assume suitable data if required.

Q.1)  (a) Obtain Y parameters in terms of Z parameters.                         (5)

      (b) Explain the properties of positive real functions.                    (5)

      (c) Find the equivalent inductance of the network shown.                  (5)
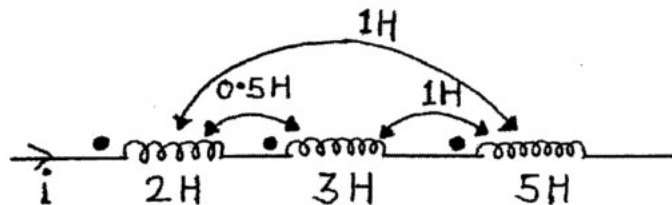


      (d) Explain various types of filters                                      (5)

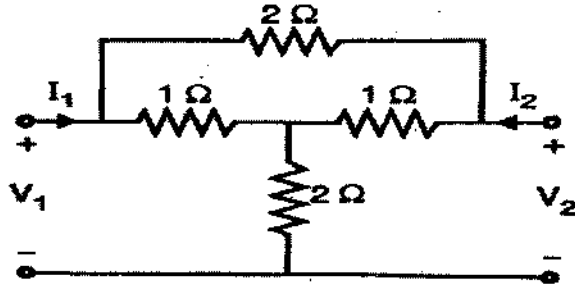Q.2)  (a) Find currents $i_1$ and $i_2$ in the given network using mesh analysis.    (10)
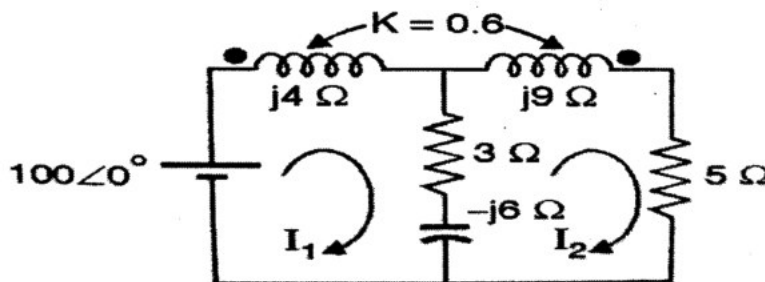


      (b) Test whether the following functions are a positive real functions. (10)

      (i) $F(S) = \dfrac{S^4+3S^3+S^2+S+2}{S^3+S^2+S+1}$     (ii) $F(S) = \dfrac{S^2+4}{S^3+3S^2+3S+1}$

**TURN OVER**

77660                                   **Page 1 of 3**

163A4613477425A40D689338444C964A

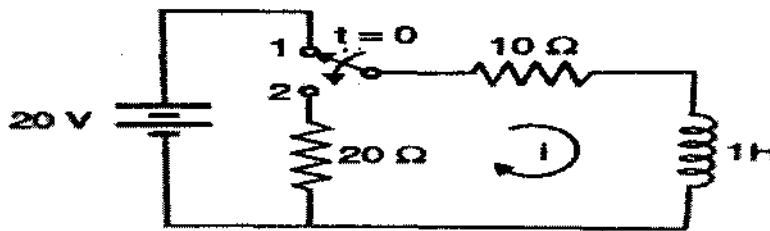Q.3) (a) Determine Y parameter of the interconnected network. (10)



(b) Test whether the following polynomials are Hurwitz polynomials. (10)

(i) $P(s) = S^4 + 5S^3 + 5S^2 + 4S + 10$
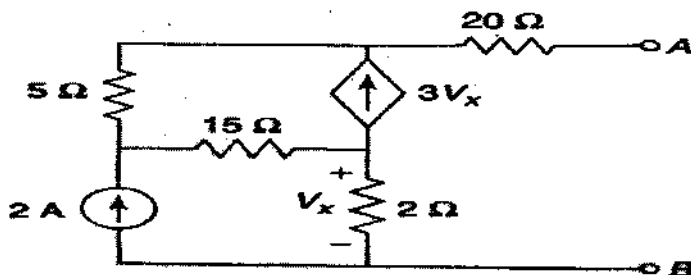
(ii) $P(s) = 2S^4 + 5S^3 + 6S^2 + 3S + 1$

Q. 4) (a) In the circuit given, switch K is changed from position 1 to position 2 at time t=0. Find i, $\dfrac{di}{dt}$, $\dfrac{d^2i}{dt^2}$ at time t=0$^+$. (10)



(b) Determine the Foster forms of realization of the RC impedance function. (10)
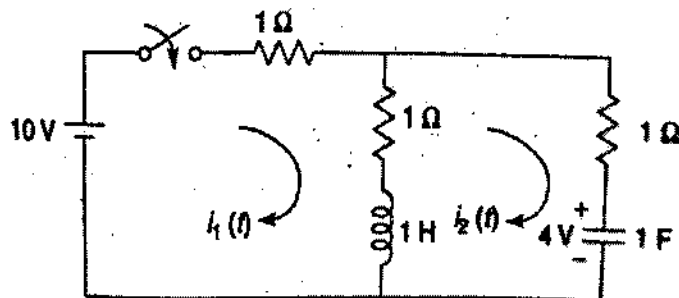
$$Z(s) = \frac{(s+1)(s+3)}{s(s+2)(s+4)}$$

Q.5) (a) Find Norton's equivalent of the following network. (10)



**TURN OVER**

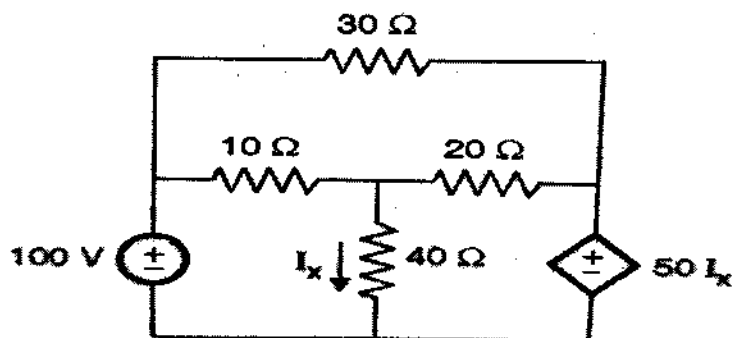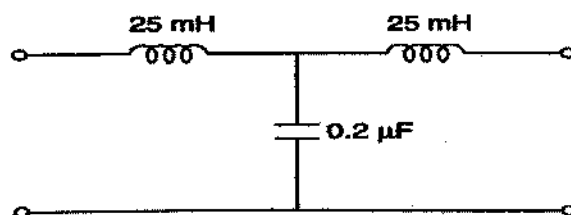(b) Find the currents $i_1$ (t) and $i_2$ (t) when initial current through the inductor is zero and initial voltage on the capacitor is 4V. (10)
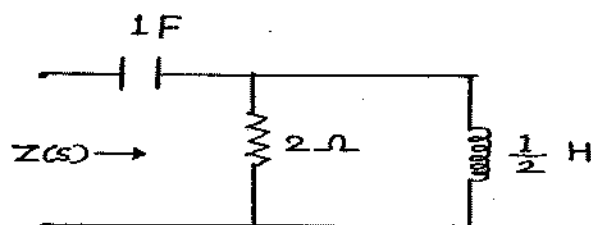


Q. 6) (a) Find current through 20Ω resistor using mesh analysis. (10)



(b) Find the nominal impedance, cut off frequency and pass band for the network. (6)



(c) Find poles and Zeros of the impedance of the following network and plot pole zero diagram. . (4)

**Time: 03Hours**                                                                 **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. No. | Attempt any **four** | **Marks** |
|---|---|---|
| Q1.(a) | The expected value of the voltage across a resistor is 80v.However the measurement gives a value of 79v. Calculate (i) absolute error, (ii) %error, (iii) relative accuracy, and (iv) %accuracy. | **5** |
| Q1.(b) | Explain Megger Bridge (Mega Ohmmeter) for high resistance measurement with diagram. | **5** |
| Q1.(c) | Draw block diagram of Dual trace and dual beam CRO. | **5** |
| Q1.(d) | Define Transducers. List selection criteria of Transducers. | **5** |
| Q1.(e) | With a neat labelled diagram explain Digital frequency meter. | **5** |
| Q1.(f) | List various types of Elastic Pressure Transducers and explain any one. | **5** |
| Q2.(a) | What are the different types of errors in measuring instruments? State the remedies to eliminate errors in the measurements. | **10** |
| Q2.(b) | Explain the measurement of unknown resistance using Kelvin Double Bridge. | **10** |
| Q3.(a) | Explain how Lissajous figures are used for measurements of unknown frequency and phase shift using cathode ray oscilloscope. | **10** |
| Q3.(b) | Draw and Explain the block diagram of Digital storage oscilloscope. List any 4 applications of DSO. | **10** |
| Q4.(a) | Describe the operation of Successive Approximation type digital voltmeter with a neat block diagram. | **10** |
| Q4.(b) | With neat labelled block diagram explain the operation of spectrum analyzer | **10** |
| Q5.(a) | Draw and explain construction and working of Linear Variable Differential Transducer and comment on Residual voltage | **10** |

Q5.(b)   Draw and explain the construction and working of Dead Weight Tester with labeled diagram.   **10**

Q6. (a)   Compare RTD, Thermocouple and Thermistor on the basis of the following parameters:   **10**
1.Principle of working
2.Characterstics
3.Range
4.Applications
5.Diagram

Q6.(b)   You are asked to measure the flow rate in a network of pipes that carry brine (a salt water solution). At first, it seems an easy task to use electromagnetic flow meters since the brine solution being highly conductive, the output signal obtained is proportional to the flow rate. However, on close inspection, you find that due to several issues: including the storage of space and the myriad of piping the flow transducer and only installed in vertical position. The plant supervisor also tells you "it should be such that" simply by looking at flowrate directly on its scale, he can adjust the valve manually and quickly so as to control it. Which flow transducer will you select for such an application? Explain with a neat diagram.   **10**

--------------------------------------*BEST OF LUCK*--------------------------------------

**Time: 3 Hrs**                                                                                    **Marks: 80**

**NB:**    (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.

**Q.1**    **Answer Any Four.**
   a)    Convert the decimal number $(175.23)_{10}$ to their octal, hexadecimal, BCD and gray code     **5m**
         equivalent.
   b)    Prove the following Boolean theorem.                                                            **5m**
         $(A+\bar{A}B) = (A+B)$
   c)    Implement CMOS inverter and NOR gate.                                                           **5m**
   d)    Design and implement half subtractor circuit.                                                  **5m**
   e)    Explain various triggering methods and symbols of flip flops.                                  **5m**

**Q.2**    a) Simplify the logic function using Quine-McClusky method.                                   **10m**
              Y (A, B, C, D) = $\Sigma$ m ( 0 ,1,2,3,5,7,8,9,11,14)
           b) Design and implement D flip flop using T flip flop and JK flip flop using D flip flop.    **10m**

**.Q.3**   a) Design and implement asynchronous MOD-9 counter using T flip                              **10m**
              flop.
           b) Draw and explain 5bit comparator using IC 7485.                                           **10m**

**Q.4**    a) Implement and explain 4-bit BCD adder using IC 7483.                                       **10m**
           b) Design and implement the following expression using a single
              8:1multiplexer .                                                                          **10m**
                 Y (A, B, C, D) = $\Sigma$ m ( 0 ,2,3,6,8,9,12,14)

**Q.5**    a) Draw and explain master slave JK flip flop with its advantage. Derive characteristics     **10m**
              equation and excitation table of JK flip-flop.
           b) Implement and explain 4-bit twisted ring counter.                                         **10m**

**Q.6**    Write a short note on **any three.**                                                         **20m**
           a) Hamming code
           b) Characteristics of logic families
           c) Static and dynamic Hazards
           d) Application of flip flop in switch debouncing

                            .......................................................................

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