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

Note:-
1) Question number **1** is **compulsory**.
2) Attempt any **three** questions from the remaining **five** questions.
3) **Figures** to the **right** indicates **full** marks

Q.1 a) Evaluate Laplace transform of $t\,e^{3t}\,sin4t$ **05**

b) Find half range fourier sine series for x^2 in $(0,\pi)$ **05**

c) Find the directional derivative of $4xz^2 + x^2yz$ at (1,-2,-1) in the direction of $2\bar{\imath} - \bar{\jmath} - 2\bar{k}$ **05**

d) Find k such that $\frac{1}{2}\log(x^2+y^2) + i\,tan^{-1}\left(\frac{kx}{y}\right)$ is analytic **05**

Q.2 a) Show that the function is Harmonic and find it's conjugate $u = e^{2x}(xcos2y - ysin2y)$ **06**

b) Evaluate $L^{-1}\left[\frac{s^2}{(s^2+9)(s^2+4)}\right]$, using convolution theorem **06**

c) Verify Green's theorem in the plane for $\int_C (xy+y^2)dx + x^2dy$, where C is the region bounded by the curves $y = x$ and $y = x^2$ **08**

Q.3 a) Solve $(D^2+2D+1)y = 3te^{-t}$, $y(0) = 4$, $y'(0) = 2$ by using Laplace tranmsform. **06**

b) Show that $\bar{F} = (4xy + 3x^2z)\bar{\imath} + (2x^2 - 2z)\bar{\jmath} + (x^3 - 2y)\bar{k}$ is conservative. Find the work done in moving a particle from $A(1,0,1)$ to $B(2,1,1)$. **06**

c) Find the Fourier series for the function $f(x) = \left(\frac{\pi - x}{2}\right)^2$ in the interval $0 \le x \le 2\pi$. Hence deduce $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots$ **08**

Q.4 a) Obtain the Fourier Series of $xcosx$ in $(-\pi,\pi)$ **06**

b) Find the bilinear transformation which maps the points $z = i, -1, 1$ onto the points $w = 0, 1, \infty$ **06**

c) Evaluate i. $L^{-1}[tan^{-1}\left(\frac{a}{s}\right)]$ ii. $L^{-1}\left[\frac{e^{-\pi s}}{s^2-2s+2}\right]$ **08**

Q.5 a) Evaluate $\int_0^\infty e^{-t}\left[t\int_0^t e^{-4u}\,cosu\,du\right]dt$ **06**

b) Show that under the transformation $w = \frac{z-i}{z+i}$, real axis in Z-plane is mapped onto the circle $|w| = 1$ **06**

c) Find the Fourier expansion of $f(x) = x^2$ in $(0,a)$. Hence deduce that $\frac{\pi^2}{-3} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} \ldots$ **08**

Q.6 a) Find the orthogonal trajectories of the family of curves $x^2 - y^2 + x = c$

b) Find the Fourier cosine integral representation of the function

$$f(x) = \begin{cases} 1 - x^2, & 0 \le x \le 1 \\ 0, & x > 1 \end{cases}$$

Hence evaluate $\int_0^\infty \left(\frac{x\cos x - \sin x}{x^3}\right) \cos\frac{x}{2}\, dx$

c) Evaluate by using Gauss Divergence theorem $\iint_S \bar{N}.\bar{F}\, ds$, where $\bar{F} = 4x\bar{\imath} + 3y\bar{\jmath} - 2z\bar{k}$. S is the surface bounded by $x=0$, $y=0$, $Z=0$ and $2x + 2y + z = 4$.

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[Time: Three Hours] **[Marks:80]**

1. Question.No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data wherever necessary.

Q1 Attempt any five questions. [20 Marks]

a) Explain any one method of full wave rectification with the help of labelled diagram.

b) How transistors can be used as switches?

c) Plot the output waveform for the circuit shown below (Fig.1).

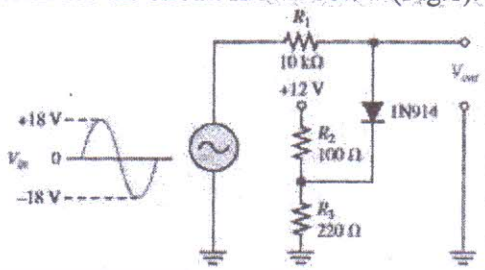

Fig.1

d) Design an inverting amplifier whose gain is variable over the range $-4 \leq A \leq 0$ by means of a 10KΩ pot.

e) Define and explain harmonic distortion.

f) Sketch the output waveform for the circuit of fig.2, if the input signal is a 5 V peak sine wave.

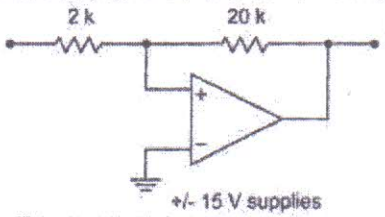

Fig.2

Q2 a) Determine V_o and I_D for the series circuit of Fig. 3. [6 Marks]

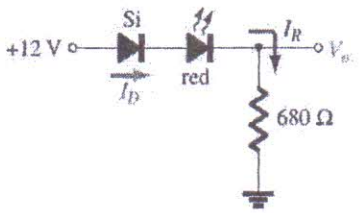

Fig. 3

b) Derive the stability factor S (Ico) for emitter stabilized Bias circuit. Calculate S(Ico) for the same circuit if R_B=510 KΩ, Rc =2.4 KΩ, R_E=1.5 KΩ, V_{CC} =2.4 KΩ and β=100. [8 Marks]

c) What are the characteristics of an ideal op-amp? Explain why open loop configurations are not used in linear applications. [6 M

Q.3 a) Find I_c and V_{EC} for the pnp transistor [6 M

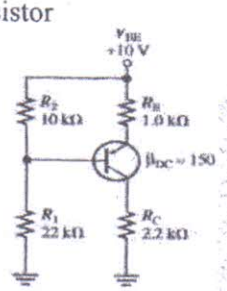

Fig.4

b) Explain thermal runaway in case of the BJT. How we can do compensation for the same. [6 Ma

c) The transistor in Fig.5 has the following maximum ratings: $P_D(max)$ =800 mW, $V_{CE}(max)$=15 V, and $I_C(max)$=100 mA. Determine the maximum value to which V_{CC} can be adjusted without exceeding a rating. Which rating would be exceeded first? [8 Ma

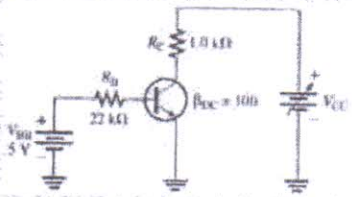

Fig.5

Q.4 a) Explain the working of D MOSFET with neat diagrams. [8 Mar
b) Explain with a neat diagram a transformer coupled audio power amplifier. [6 Mar
c) Sketch the 3-input inverting averaging circuit and derive an equation for the output voltage. [6 Mar

Q.5 a) Write the design procedure for High pass filter with suitable example. [8 Mar
b) What are the conditions for stable oscillations? Draw the circuit of Wein Bridge oscillator and derive equations for frequency and gain. [6 Mar
c) What is the basic difference between a basic comparator and the Schmitt trigger. For an inverting Schmitt trigger if R_1=180Ω, R_2=80KΩ, V_{in}=500mV_{pp} sine wave, and the saturation voltages are ±15V. Determine upper, lower threshold voltage and hysteresis voltage. [6 Mar

Q.6 a) Draw and explain series voltage regulator. [6 Marks]

b) Explain four types of controlled sources using opamp. [6 Marks]

c) Derive the expression for the circuit shown below, Plot the waveforms for output voltage of the ideal op-amp shown in fig.6 for the triangular-wave input shown below. [8 Marks]

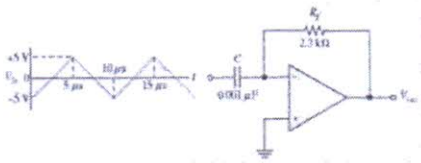

Fig.6

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[Time: Three Hours] [Marks:80]

N.B: 1. Question.No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data wherever necessary.

1 Attempt **any four** : 20

a Explain absolute humidity and relative humidity.
b What do you mean by calibration? What is the need of calibration?
c Explain sensor characteristics i) Hysteresis and ii) Linearity.
d What is base metal and rare metal thermocouples? State their advantages and disadvantages.
e Explain liquid level measurement using float and LVDT with appropriate diagram .

2 a Explain different types of errors in measurements with their remedies. 10
b Explain flapper nozzle system and comment on its application. 10

3 a Explain radioactive type level detector in detail. 10
b A capacitive transducer uses two quartz diaphragms of area 750 mm^2 separated by a distance of 3.5 mm .A pressure of 900 kN/m^2 when applied to the top diaphragm produces a deflection of 0.6 mm .The capacitance is 370 pF when no pressure is applied to the diaphragms .Find the value of capacitance after the application of a pressure of 900 kN/m^2. 10

4 a State different types of pyrometers .Explain with a neat sketch any one of them. 10
b State and explain laws of intermediate temperature and intermediate metals of thermocouple.Write the significance of these laws . 10

5 a Explain construction and working principle of LVDT. 10
b A linear resistance potentiometer is 50 mm long and is uniformly wound with a wire having a resistance of 10 K .ΩUnder normal conditions, the slider is at the center of the potentiometer .Find the linear displacement when the resistance of the potentiometer as measured by a Wheatstone bridge for two cases is i) 3850Ω ii) 7560. Ω Are the two displacements in the same direction? If it is possible to measure a minimum value of 10 Ωresistance with the above arrangement, find the resolution of the potentiometer in mm. 10

6 Write a short note on **(Any two)** :- 20
a Hall Effect Transducer
b Sound Pressure Level meter
c Air purge type level gauge.
d Lead wire compensation in RTD

(3 Hours) [Total Marks: 80]

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

1. Answer the following: - [20]
   (a) Implement EX- OR logic gate using NAND gates.
   (b) Explain Fan-In and Fan-Out of digital ICs.
   (c) Explain the working of SR flip flop? What is meant by edge triggering?
   (d) Implement f (ABC) = ∑m (1,2,5) using 4:1 MUX.

2. (a) Prove the following using Boolean algebra. [10]
   i) $(A+\bar{B}+AB)(A+\bar{B})(\bar{A}B) = 0$
   ii) $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC = AB + AC + BC$
   (b) Perform-: i) $(24)_8 - (10)_8$ ii) $(64)_{16} + (33)_{16}$ [05]
   (c) Convert: [05]
   i) $(9CD)_{16} = (?)_{10}$ ii) $(0.42)_{10} = (?)_2$

3. (a) Design a 4 bit BCD adder using IC 7483. [10]
   (b) Design two-bit magnitude Comparator using logic gates. [10]

4. (a) Design 3 bit synchronous counter using JK flip- flop. [10]
   (b) Explain with a neat diagram working of SISO shift register. Draw necessary timing diagram. [10]

5. (a) What is FPGA? What are its salient features? [05]
   (b) What are the merits and demerits of TTL family? [05]
   (c) Design and implement a full subtractor circuit using 3: 8 Decoder. [10]

6. Write note on: - **(Any Four)** [20]
   (a) Hazards and Hazard elimination.
   (b) PAL and PLA.
   (c) Advantages of 2's complement number representation.
   (d) ASCII Code.
   (e) Basic dynamic RAM Cell.

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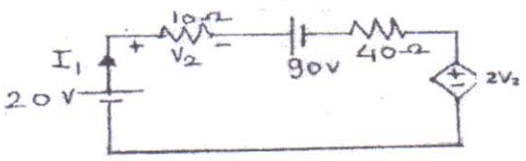
[Time: Three Hours] [Marks:80]

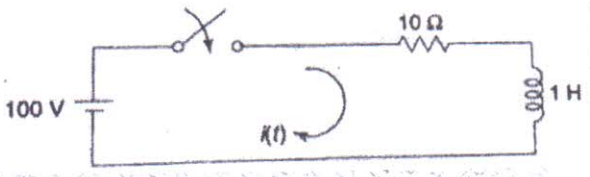
N.B: 1. Question.No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data wherever necessary.

Attempt the following: 20

a. Find the value of I_1



b. In the given network the switch is closed at t= 0. With zero current in the inductor find i, $\frac{di}{dt}$, at t= 0^+



c. What are the advantages of an A.C. Bridge?

d. Obtain pole-zero plot of the following function

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

2 a. Explain construction and working of D'Arsonaval Galvanometer. 10

b. Test whether polynomial is Hurwitz; 10

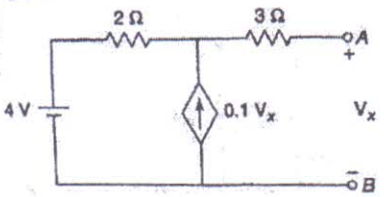
i) $P(s)=s^4+s^3+5s^2+3s+4$

ii) $P(s)=s^5+3s^3+2s$

3 a. State how you will derive the expression for frequency in case of Wien Bridge. 10

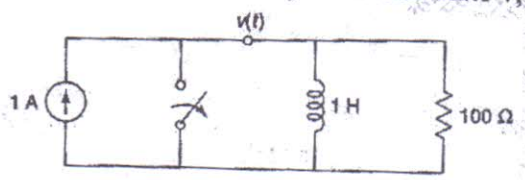
b. Explain construction and working of PMMC instrument. 10

4 a. Find Thevenin's equivalent network 10

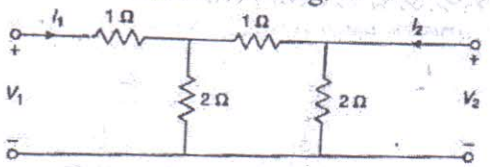


TURN OVER

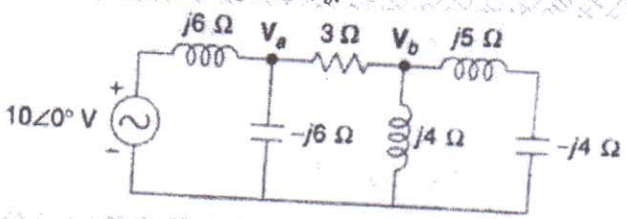
b In the network shown in fig. At t=0, the switch is opened. Calculate v, $\frac{dv}{dt}$ at t=0+



5 a Obtain ABCD parameters for the network shown in fig.



b In the network shown below determine V_a and V_b.



6 a What are Q meters and how do they work?

b For the network shown below, calculate the maximum power that may be dissipated in load resistor R_L