(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 $x^2 - y^2 + x = c$ **06**

b) Find the Fourier cosine integral representation of the function 06

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

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

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 $2x + 2y + z = 4$. 08

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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.

Q.1 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).

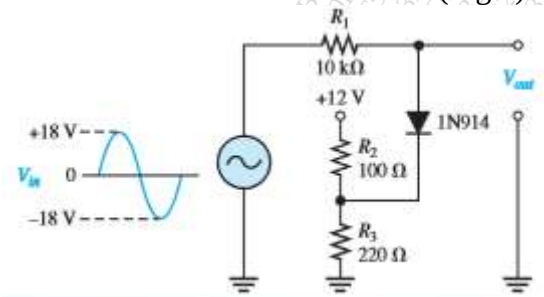


Fig.1

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.

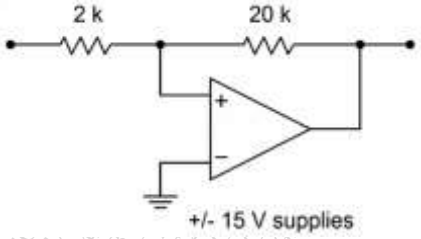


Fig.2

Q.2 a) Determine V_o and I_D for the series circuit of Fig. 3. [6 Marks]

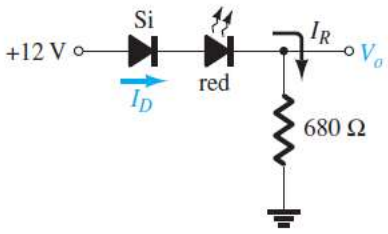


Fig. 3

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 Marks]

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

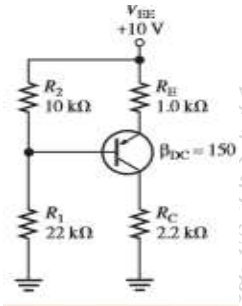


Fig.4

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

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 Marks]

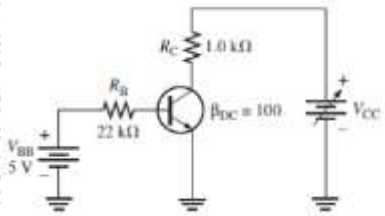


Fig.5

Q.4 a) Explain the working of D MOSFET with neat diagrams. [8 Marks]

b) Explain with a neat diagram a transformer coupled audio power amplifier. [6 Marks]

c) Sketch the 3-input inverting averaging circuit and derive an equation for the output voltage. [6 Marks]

Q.5 a) Write the design procedure for High pass filter with suitable example. [8 Marks]

b) What are the conditions for stable oscillations? Draw the circuit of Wein Bridge oscillator and derive equations for frequency and gain. [6 Marks]

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 Marks]

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]

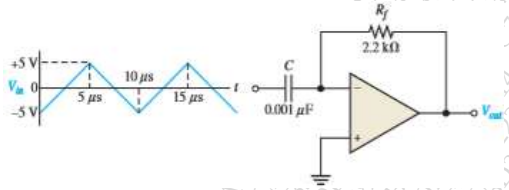


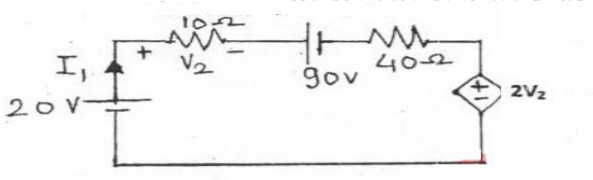
Fig.6

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

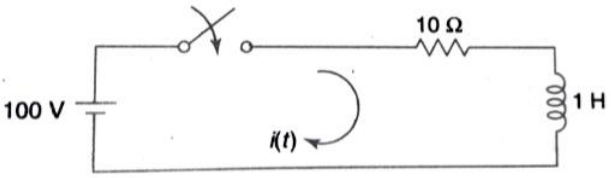
N.B: 1. Question.No.1 is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data wherever necessary.

1 Attempt 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

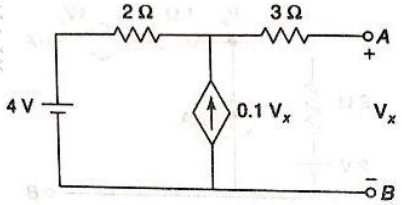
i) $P(s)=s^4+s^3+5s^2+3s+4$

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

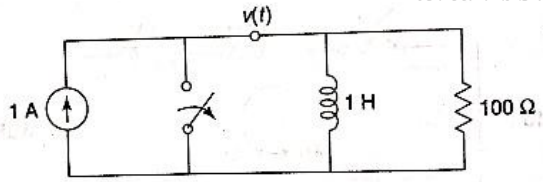
b Explain construction and working of PMMC instrument. 10

4 a Find Thevenin's equivalent network 10

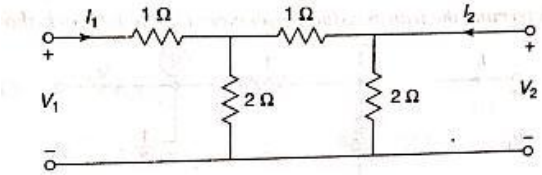


TURN OVER

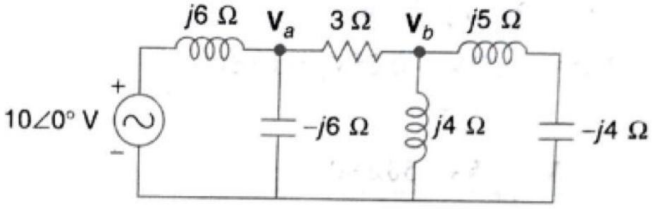
b In the network shown in fig. At t=0, the switch is opened. Calculate v, $\frac{dv}{dt}$ at t=0+ 10



5 a Obtain ABCD parameters for the network shown in fig. 10



b In the network shown below determine V_a and V_b. 10



6 a What are Q meters and how do they work? 10

b For the network shown below, calculate the maximum power that may be dissipated in load resistor R_L 10