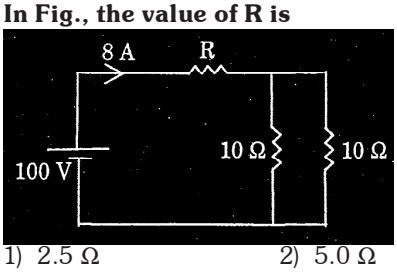
# 2011

## PART 06 – ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING

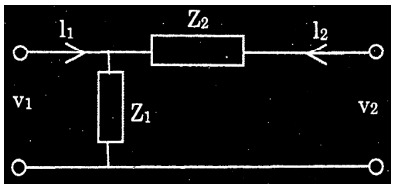
**(Answer ALL questions)**

**76. In Fig., the value of R is**



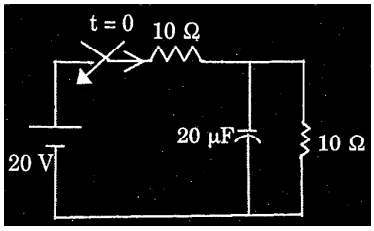

1) 2.5 Ω 2) 5.0 Ω
3) 7.5 Ω 4) 10.0 Ω

**77. The RMS value of the voltage $u(t)=3+4\cos(3t)$ is**




1) $\sqrt{17}$V 2) 5 V
3) 7 V 4) $\left(3+2\sqrt{2}\right)$V

**78. In Fig., the initial capacitor voltage is zero. The switch is closed at t=0. The final steady-state voltage across the capacitor is**




1) 20 V 2) 10 V 3) 5 V 4) 0 V

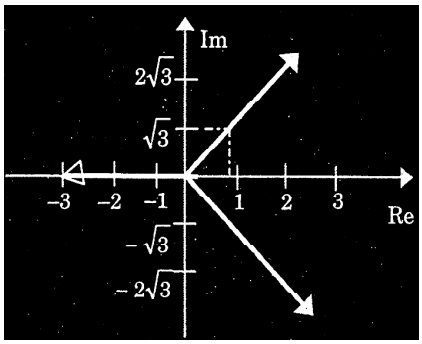
**79. A system with zero initial conditions has the closed loop transfer function $T(s)=\frac{s^2+4}{(s+1)(s+4)}$. The system output is zero at the frequency.**

1) 0.5 rad/sec 2) 1 rad/sec
3) 2 rad/sec 4) 4 rad/sec

**80. A three-phase diode bridge rectifier is fed from a 400V RMS, 50 Hz, three-phase AC source. If the load is purely resistive, the peak instantaneous output voltage is equal to**

1) 400 V 2) $400\sqrt{2}$V
3) $400\sqrt{\frac{2}{3}}$V 4) $\frac{400}{\sqrt{3}}$V

**81. Fig. shows the root locus plot (location of poles not given) of a third order system whose open loop transfer function is**

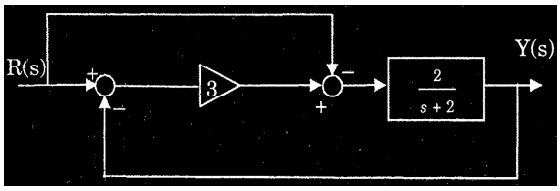



1) $\frac{K}{s^3}$ 2) $\frac{K}{s^2(s+1)}$
3) $\frac{K}{s(s^2+1)}$ 4) $\frac{K}{s(s^2-1)}$

**82. A unity feedback system, having an open loop gain $G(s)H(s)=\frac{K(1-s)}{(1+s)}$, becomes stable when**

1) $|K|>1$ 2) $K>1$
3) $|K|<1$ 4) $K<-1$

**83. When subjected to a unit step input, the closed loop control system shown in Fig. will have a steady state error of**




1) –1.0 2) –0.5
3) 0 4) 0.5

**84. In the GH(s) plane, the Nyquist plot of the loop transfer function $G(s)H(s)=\frac{\pi e^{-0.25s}}{s}$ passes through the negative real axis at the point**

1) (–0.25, j0) 2) (–0.5, j0)
3) (–1, j0) 4) (–2, j0)

**85. The equivalent circuit of a transformer has leakage reactance $X_1$, $X'_2$ and magnetizing reactance $X_M$. Their magnitudes satisfy**

1) $X_1 >> X'_2 >> X_M$
2) $X_1 << X'_2 << X_M$
3) $X_1 = X'_2 >> X_M$
4) $X_1 = X'_2 << X_M$

**86. Which three-phase connection can be used in a transformer to introduce a phase difference of 30° between its output and corresponding input lines voltages?**

1) Star-Star 2) Star–Delta
3) Delta-Delta 4) Delta-Zigzag

**87. For an induction motor, operating at a slip s, the ratio of gross power output to air gap power is equal to**

1) $(1-s)^2$ 2) $(1-s)$
3) $\sqrt{(1-s)}$ 4) $\left(1-\sqrt{s}\right)$

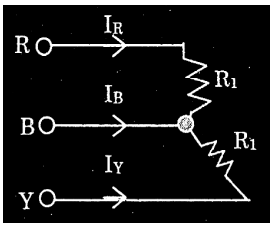
**88. The p.u. parameters for a 500 MVA machine on its own base are.**
**inertia M=20 p.u.; reactance X=2 p.u.**
**The p.u. values of inertia and reactance on 100 MVA common base, respectively, are**

1) 4, 0.4 2) 100, 10
3) 4, 10 4) 100, 0.4

**89. An 800 kV transmission line has a maximum power transfer capacity operated at 400 kV with the series reactance unchanged, the new maximum power transfer capacity is approximately.**

1) P 2) 2P
3) $\frac{P}{2}$ 4) $\frac{P}{4}$

**90. For the three-phase circuit shown in Fig., the ratio of the current $I_g : I_y : I_B$ is given by**




1) $1:1:\sqrt{3}$ 2) 1:1:2
3) 1:1:0 4) $1:1:\sqrt{\frac{3}{2}}$

**91. The positive, negative and zero sequence impedances of a solidly grounded system under steady state condition always follow the relation**

1) $z_1 > z_2 > z_0$ 2) $z_1 < z$
3) $z_0 < z_1 > z_2$ 4) None of the above

**92. The relay operating coil is supplied through**

1) Fuse 2) Power transformers
3) Instrument transformers 4) None of the above

**93. The inertia constants of two groups of machines which do not swing together are $M_1$ and $M_2$. The equivalent inertia constant of the system is**

1) $M_1+M_2$ 2) $\sqrt{M_1+M_2}$
3) $M_1M_2 / M_1+M_2$ 4) $M_1+M_2 / M_1M_2$

**94. TRIAC is**

1) a bidirectional thyristor
2) a combination of 2 PNPN diodes
3) another name for high power thyristor
4) a power BJT

**95. An SCR can withstand a maximum temperature of 120°C with an ambient temperature of 75°C. If this SCR has thermal resistance from junction to ambient as 1.5°C/W, the maximum internal power dissipation allowed is**

1) 90 W 2) 60 W 3) 30 W 4) 100 W

**96. A microprocessor data bus has 16 lines and its address bus contains 12 lines. The number of bytes in the memory will be**

1) 2K 2) 4K 3) 8K 4) 16K

**97. The Q output of a JK flip flop is 'I'. The output does not change when the clock pulse is applied. The inputs J and K will be respectively (where 'x' - don't care state)**

1) 0 and x 2) x and 0
3) 1 and 0 4) 0 and 1

**98. Which one of the following will give the sum of full-adder as output?**

1) Three input majority circuit
2) Three bit parity checker
3) Three bit comparator
4) Three bit counter

**99. The frequency response of Chebyshev Type-I IIR filter has**

1) a monotonic passband and stopband
2) a monotonic passband and ripples in the stopband
3) ripples in both passband and stopband
4) ripples in the passband and a monotonic stopband

**100. The convolution of a function f(t) with unit impulse is**

1) f(–t) 2) f(t) 3) δ(t) 4) δ(–t)

**101. Minimum sampling rate when spectral range of a function extends from 10 MHz to 10.2 MHz is**

1) 0.2 MHz 2) 0.4 MHz
3) 0.6 MHz 4) 0.8 MHz

**102. Inverse Fourier transform of Sgn(ω) is**

1) $-j / \pi t$ 2) $j / \pi t$ 3) $1 / \pi t$ 4) $-1 / \pi t$

**103. The address field of a frame in HDLC protocol contains the address of the ––––– station.**

1) secondary 2) primary
3) tertiary 4) repeater

**104. The –––––– layer decides the location of synchronisation points.**

1) network 2) transport
3) presentation 4) session

**105. When the gain margin of the system is close to unity and the phase margin is close to zero, then the system is**

1) highly stable 2) oscillatory
3) relatively stable 4) unstable

**106. The characteristic equation of a system is $s^4+6s^3+11s^2+6s+k=0$. In order to ensure the system be stable, k must be**

1) greater than zero and less than 10
2) less than zero and greater than 10
3) unity
4) zero

**107. Diffraction of EM waves**

1) is caused by reflection from the ground
2) rise only with spherical wavefronts
3) will occur when the waves pass through a large slot
4) may occur around the edge of a sharp obstacle

**108. A quarter wave transformer is used for matching the transmission line to the load $Z_L$ when $Z_L$ is**

1) high 2) low
3) purely resistive 4) complex

**109. Frequencies in UHF range propagate by means of**

1) ground waves 2) sky waves
3) space waves 4) surface waves

**110. In a PCM, the amplitude levels are transmitted in a 7 unit code. The sampling is done at the rate of 10 KHz. The bandwidth should be**

1) 35 KHz 2) 70 KHz 3) 5 MHz 4) 5 KHz

**111. An open tank contains a liquid of varying density and the level within the tank must be accurately measured. The best choice of measuring system would be**

1) Bubble tube
2) Diaphragm box
3) Float and cable
4) Head type with differential pressure transmitter

**112. A lithium chloride element is usually calibrated to read**

1) Relative humidity 2) Wet bulb temperature
3) Absolute humidity 4) Dew point

**113. The purpose of using extension lead wires that have the same thermoelectric characteristics as the thermocouple is to**

1) prevent corrosion at all junctions
2) extend the reference junction back to the instrument
3) prevent creating an unwanted reference junction
4) make the thermocouple system operate in standard fashion

**114. The three factors that control the conductivity of an electrolyte are**

1) specific gravity, density and volume
2) concentration, material in solution and temperature
3) color index, turbidity and temperature
4) Hydrogen ion concentration, temperature and pressure

**115. An industrial effluent stream is to be neutralized by adding a sodium hydroxide solution. The best choice of analytical measurement for the control system would be**

1) Conductivity
2) pH
3) Oxidation-reduction potential
4) Capacitance

**116. The most popular carrier gas used in gas chromatograph is**

1) Helium 2) Air
3) Hydrogen 4) Oxygen

**117. Two inductive transducers working on the principle of change of self induction L, are connected in a push pull arrangement. If the change of inductance of transducer s is $\Delta L$ the change of inductance exhibited at the output terminal is**

1) $\Delta L$ 2) $2\Delta L$ 3) $\pm 2\Delta L$ 4) 0

**118. A true RMS reading voltmeter uses two thermocouples in order**

1) to increase the sensitivity
2) that the second thermocouple cancels out the non linear effect of the first thermocouple
3) to prevent the drift in the D.C. amplifier
4) All of the above

**119. The controlling torque in single phase power factor meter is provided by**

1) Spring control 2) Gravity control
3) Stiffness of suspension 4) None of the above

**120. Creeping in a single phase induction type energy meter may be due to**

1) Overcompensation for friction
2) Over voltage
3) Vibration
4) All of the above

## ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGG.-2011 : ANSWERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 76 ..... 3 | 77 ..... 1 | 78 ..... 2 | 79 ..... 3 | 80 ..... 2 | 81 ..... 1 | 82 ..... 3 | 83 ..... 3 | 84 ..... 2 | 85 ..... 4 |
| 86 ..... 2 | 87 ..... 2 | 88 ..... 4 | 89 ..... 4 | 90 ..... 1 | 91 ..... 1 | 92 ..... 2 | 93 ..... 1 | 94 ..... 1 | 95 ..... 3 |
| 96 ..... 2 | 97 ..... 2 | 98 ..... 1 | 99 ..... 4 | 100 ..... 2 | 101 ..... 1 | 102 ..... 1 | 103 ..... 1 | 104 ..... 4 | 105 ..... 1 |
| 106 ..... 1 | 107 ..... 4 | 108 ..... 4 | 109 ..... 1 | 110 ..... 4 | 111 ..... 4 | 112 ..... 1 | 113 ..... 4 | 114 ..... 2 | 115 ..... 2 |
| 116 ..... 1 | 117 ..... 4 | 118 ..... 2 | 119 ..... 1 | 120 ..... 4 | | | | | |

**76. (2)**

$$\frac{100}{R+5} = 8;\ R=7.5\ \Omega$$

**77. (1)**

$u(t) = 3+4\cos(3t)$ and $\omega=3$

$$T = \frac{2\pi}{3}$$

$$\text{RMS value of } u(t) = \sqrt{\frac{1}{T}\int_0^T \{u(t)\}^2}$$

$$= \sqrt{\frac{3}{2\pi}\int_0^{2\pi/3} (3+4\cos 3t)^2} = \sqrt{17}$$

**78. (2)**

At $t=0^+$, the capacitor is uncharged.

At steady state condition, capacitor is open circuited.

$$V_C(\infty) = \frac{20}{10+10}\times 10 = 10\ V$$

**79. (3)**

$$|T(j\omega)| = \frac{\left|(j\omega)^2+4\right|}{(j\omega+1)(j\omega+4)} = 0$$

$$-\omega^2+4 = 0$$

$$\omega = 2\ \text{rad/sec.}$$

**80. (2)**

Since load is purely resistive, peak instantaneous,

$$V_0 = \sqrt{2}\ V_{rms}$$

$$= 400\sqrt{2}\ \text{volts}$$

**81. (1)**

$$G(S)\,H(S) = \frac{K}{S^3}$$

Characteristic equation is, $1+G(S)\,H(S)=0$

$$S^3+K = 0$$

$$\frac{dK}{dS} = 0$$

$$3S^2 = 0$$

$$S = 0, 0$$

In all other options, all breaking points are not at origin.

**82. (3)**

$$1+G(S)\,H(S) = 0$$

$$(1-K)S+(1+K) = 0$$

$$S(1-K)>0$$

$$(1+K)>0$$

$$|K|<1$$

**83. (3)**

$$M(S) = R(S)+[R(S)-Y(S)]\frac{3}{S}$$

$$Y(S) = \frac{2}{S+2}\left[R(S)\left[1+\frac{3}{S}\right]-\frac{3}{S}Y(S)\right]$$

$$\frac{Y(S)}{R(S)} = \frac{2(S+3)}{S^2+2S+6}$$

$$E(S) = R(S)-Y(S) = R(S)\left[1-\frac{2(S+3)}{S^2+2S+6}\right]$$

$$E(S) = R(S)\frac{S^2}{S^2+2S+6}$$

$$e_{SS} = \lim_{S\to 0} SE(S) = 0$$

**84. (2)**

$$G(s)\,H(s) = \frac{\pi e^{-0.25s}}{s}$$

$$G(js)\,H(jw) = \frac{\pi\left[\cos(0.25\omega)-j\sin(0.25\omega)\right]}{j\omega}$$

$$= \frac{-\pi}{\omega}\sin(0.25\omega) - j\frac{\pi}{\omega}\cos(0.25\omega)$$

Imaginary part = 0 ; $\frac{\pi}{\omega}\cos(0.25\omega) = 0$

$\frac{\omega}{4} = \frac{\pi}{2} \Rightarrow \omega = 2\pi$

$$\therefore \left|G(j\omega)H(j\omega)\right|_{\omega=2\pi} = \left|\frac{-\pi}{2\pi}\sin\left(\frac{2\pi}{4}\right)\right| = \left|\frac{-1}{2}\right| = -0.5$$

**95. (3)**

$$p_{max} = \frac{T_j - T_A}{\theta_j A} = \frac{120-75}{1.5} = 30\ W$$

**96. (2)**

$2^n = 2^{12} = 4k$

**110. (4)**

Bandwidth = $\frac{1}{2}$ sampling rate