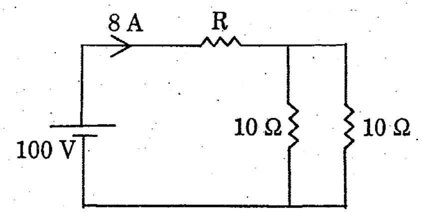
2011

PART 06 – ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING

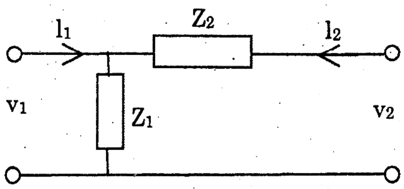
(Answer ALL questions)

76. In Fig., the value of R is



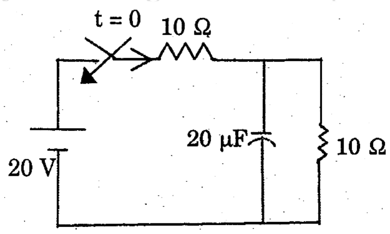
1) 2.5 Ω 2) 5.0 Ω
3) 7.5 Ω 4) 10.0 Ω

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

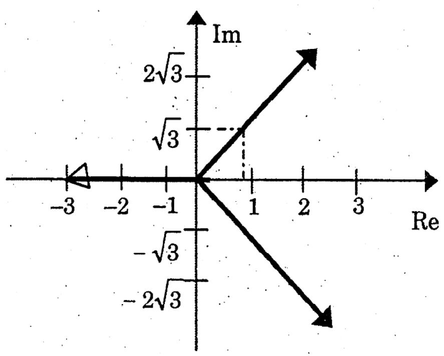
79. A system with zero initial conditions has the closed loop transfer function $T(s)=\dfrac{s^2+4}{(s+1)(s+4)}$. The system output is zero at the frequency.

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

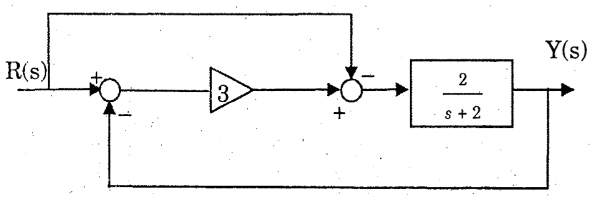


1) $\frac{K}{s^3}$ 2) $\frac{K}{s^2(s+1)}$
3) $\frac{K}{s\left(s^2+1\right)}$ 4) $\frac{K}{s\left(s^2-1\right)}$

82. A unity feedback system, having an open loop gain $G(s)H(s)=\dfrac{K(1-s)}{(1+s)}$, 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 $G(s)H(s)=\dfrac{\pi e^{-0.25s}}{s}$ 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) $\left(1-\sqrt{s}\right)$

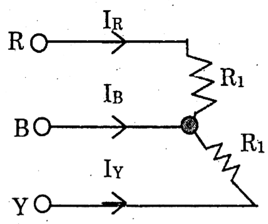
88. The p.u. parameters for a 500 MVA machine on its own base are.
inertia M=20 p.u.; reactance X=2 p.u.
The p.u. values of inertia and reactance on 100 MVA common base, respectively, are

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) $\dfrac{P}{2}$ 4) $\dfrac{P}{4}$

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) $1:1:\sqrt{\dfrac{3}{2}}$

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 ΔL the change of inductance exhibited at the output terminal is**
1) ΔL 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					

DETAILED SOLUTIONS

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.

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

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)

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

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

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

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

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

$$e_{SS} = \underset{S\to 0}{\mathrm{Lt}}\ SE(S) = 0$$

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

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

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

95. (3)

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

96. (2)

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

110. (4)

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