Graduate Aptitude Test in Engineering 2017

Question Paper Name: Electrical Engineering 11th Feb 2017 Session 1
Subject Name: Electrical Engineering
Duration: 180
Total Marks: 100

Organizing Institute:

Indian Institute of Technology Roorkee

Question Number : 1 **Correct : 1 Wrong : -0.33**

The matrix $\mathbf{A}=\begin{bmatrix} \frac{3}{2} & 0 & \frac{1}{2} \\ 0 & -1 & 0 \\ \frac{1}{2} & 0 & \frac{3}{2} \end{bmatrix}$ has three distinct eigenvalues and one of its eigenvectors is $\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$.

Which one of the following can be another eigenvector of $\mathbf{A}$?

(A) $\begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$ (B) $\begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}$ (C) $\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}$ (D) $\begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$

Question Number : 2 **Correct : 1 Wrong : -0.33**

For a complex number z, $\lim_{z \to i} \dfrac{z^2+1}{z^3+2z-i\left(z^2+2\right)}$ is

(A) $-2i$ (B) $-i$ (C) i (D) $2i$

Question Number : 3 **Correct : 1 Wrong : -0.33**

Let $z(t) = x(t) * y(t)$, where "$*$" denotes convolution. Let c be a positive real-valued constant. Choose the correct expression for $z(ct)$.

(A) $c \cdot x(ct) * y(ct)$ (B) $x(ct) * y(ct)$ (C) $c \cdot x(t) * y(ct)$ (D) $c \cdot x(ct) * y(t)$

Question Number : 4 **Correct : 1 Wrong : -0.33**

A solid iron cylinder is placed in a region containing a uniform magnetic field such that the cylinder axis is parallel to the magnetic field direction. The magnetic field lines inside the cylinder will

(A) bend closer to the cylinder axis
(B) bend farther away from the axis
(C) remain uniform as before
(D) cease to exist inside the cylinder

Question Number : 5 **Correct : 1 Wrong : -0.33**

Consider an electron, a neutron and a proton initially at rest and placed along a straight line such that the neutron is exactly at the center of the line joining the electron and proton. At $t = 0$, the particles are released but are constrained to move along the same straight line. Which of these will collide first?

(A) the particles will never collide
(B) all will collide together
(C) proton and neutron
(D) electron and neutron

Question Number : 6 **Correct : 1 Wrong : -0.33**

The transfer function of a system is given by,

$$\frac{V_o(s)}{V_i(s)} = \frac{1-s}{1+s}$$

Let the output of the system be $v_o(t) = V_m sin(\omega t + \varphi)$ for the input, $v_i(t) = V_m sin(\omega t)$. Then the minimum and maximum values of φ (in radians) are respectively

(A) $\frac{-\pi}{2}$ and $\frac{\pi}{2}$ (B) $\frac{-\pi}{2}$ and 0 (C) 0 and $\frac{\pi}{2}$ (D) $-\pi$ and 0

Question Number : 7 **Correct : 1 Wrong : -0.33**

Consider the system with following input-output relation

$$y[n] = (1 + (-1)^n)\, x[n]$$

where, $x[n]$ is the input and $y[n]$ is the output. The system is
(A) invertible and time invariant
(B) invertible and time varying
(C) non-invertible and time invariant
(D) non-invertible and time varying

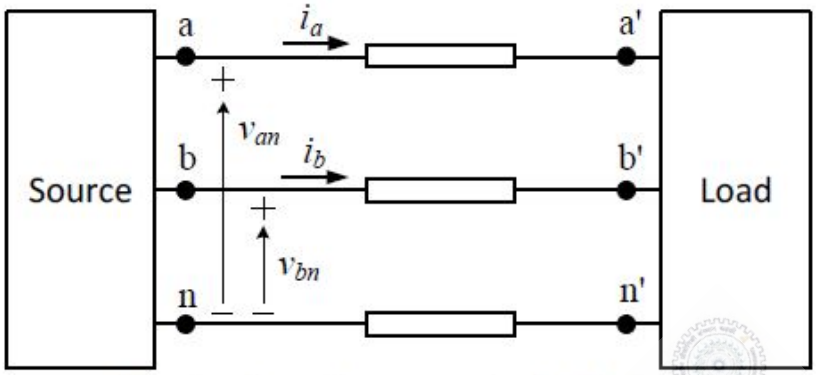
Question Number : 8 **Correct : 1 Wrong : -0.33**

A 4 pole induction machine is working as an induction generator. The generator supply frequency is 60 Hz. The rotor current frequency is 5 Hz. The mechanical speed of the rotor in RPM is

(A) 1350 (B) 1650 (C) 1950 (D) 2250

Question Number : 9 Correct : 1 Wrong : -0.33

A source is supplying a load through a 2-phase, 3-wire transmission system as shown in figure below. The instantaneous voltage and current in phase-a are $v_{an} = 220\sin(100\pi t)$ V and $i_a = 10\sin(100\pi t)$ A, respectively. Similarly for phase-b, the instantaneous voltage and current are $v_{bn} = 220\cos(100\pi t)$ V and $i_b = 10\cos(100\pi t)$ A, respectively.



The total instantaneous power flowing from the source to the load is

(A) 2200 W

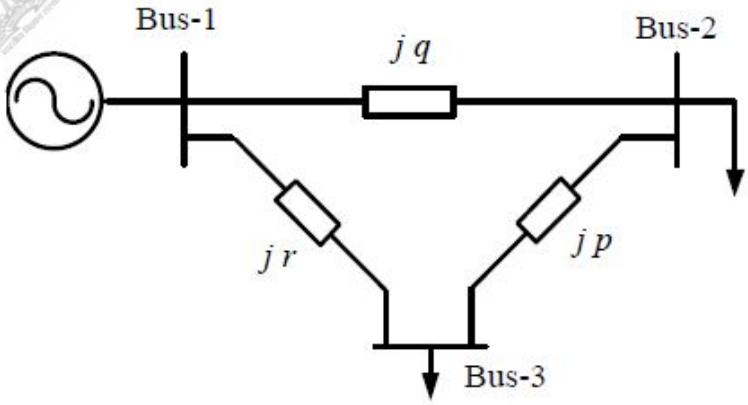
(B) $2200\sin^2(100\pi t)$ W

(C) 4400 W

(D) $2200\sin(100\pi t)\cos(100\pi t)$ W

Question Number : 10 Correct : 1 Wrong : -0.33

A 3-bus power system is shown in the figure below, where the diagonal elements of Y-bus matrix are: $Y_{11} = -j12$ pu, $Y_{22} = -j15$ pu and $Y_{33} = -j7$ pu.



The per unit values of the line reactances p, q and r shown in the figure are

(A) $p = -0.2,\ q = -0.1,\ r = -0.5$

(B) $p = 0.2,\ q = 0.1,\ r = 0.5$

(C) $p = -5,\ q = -10,\ r = -2$

(D) $p = 5,\ q = 10,\ r = 2$

Question Number : 11 **Correct : 1 Wrong : -0.33**

A closed loop system has the characteristic equation given by $s^3 + Ks^2 + (K+2)s + 3 = 0$. For this system to be stable, which one of the following conditions should be satisfied?

(A) $0 < K < 0.5$ (B) $0.5 < K < 1$ (C) $0 < K < 1$ (D) $K > 1$

Question Number : 12 **Correct : 1 Wrong : -0.33**

The slope and level detector circuit in a CRO has a delay of 100 ns. The start-stop sweep generator has a response time of 50 ns. In order to display correctly, a delay line of

(A) 150 ns has to be inserted into the y-channel
(B) 150 ns has to be inserted into the x-channel
(C) 150 ns has to be inserted into both x and y channels
(D) 100 ns has to be inserted into both x and y channels

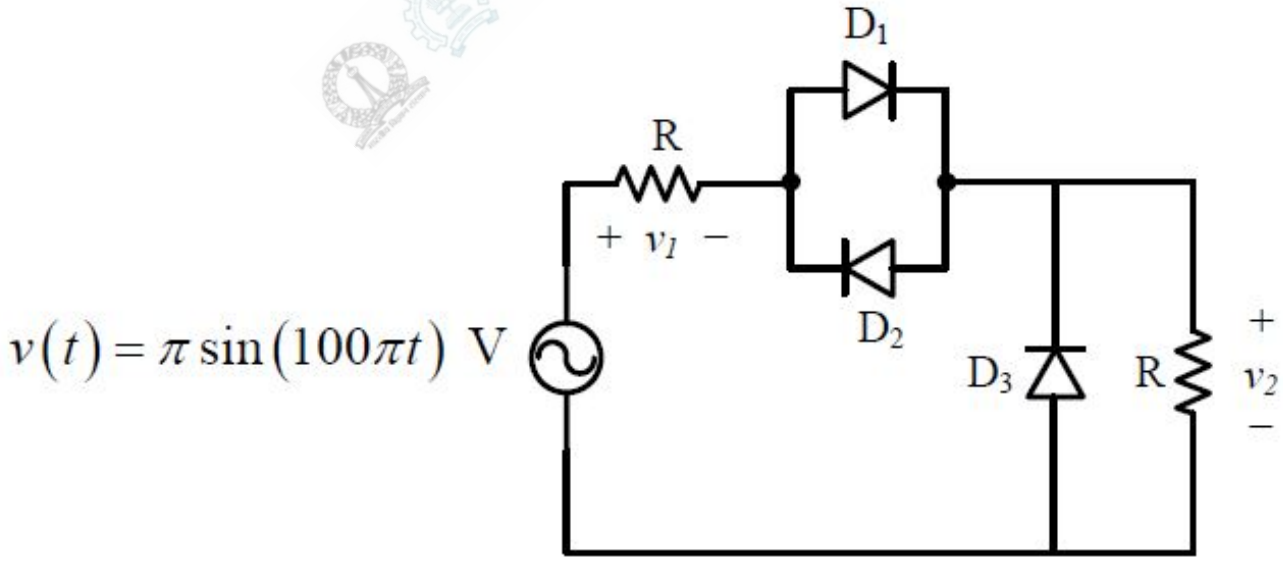
Question Number : 13 **Correct : 1 Wrong : -0.33**

The Boolean expression $AB + A\bar{C} + BC$ simplifies to

(A) $BC + A\bar{C}$ (B) $AB + A\bar{C} + B$
(C) $AB + A\bar{C}$ (D) $AB + BC$

Question Number : 14 **Correct : 1 Wrong : -0.33**

For the circuit shown in the figure below, assume that diodes D_1, D_2 and D_3 are ideal.



$v(t) = \pi \sin(100\pi t)$ V

The DC components of voltages v_1 and v_2, respectively are

(A) 0 V and 1 V (B) −0.5 V and 0.5 V
(C) 1 V and 0.5 V (D) 1 V and 1 V

Question Number : 15 Correct : 1 Wrong : -0.33

For the power semiconductor devices IGBT, MOSFET, Diode and Thyristor, which one of the following statements is TRUE?

(A) All the four are majority carrier devices.

(B) All the four are minority carrier devices.

(C) IGBT and MOSFET are majority carrier devices, whereas Diode and Thyristor are minority carrier devices.

(D) MOSFET is majority carrier device, whereas IGBT, Diode, Thyristor are minority carrier devices.

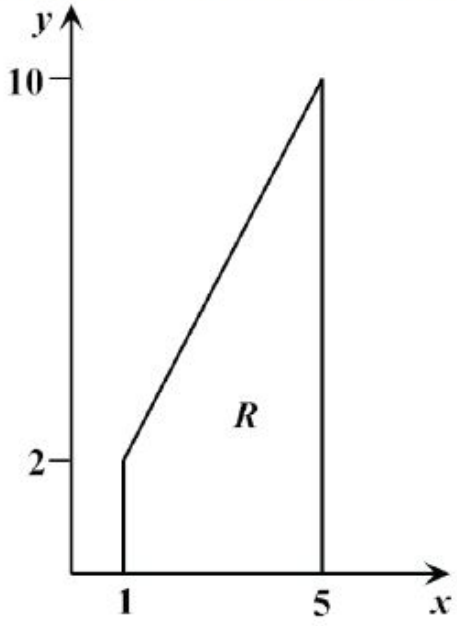
Question Number : 16 Correct : 1 Wrong : 0

Consider $g(t) = \begin{cases} t - \lfloor t \rfloor, & t \geq 0 \\ t - \lceil t \rceil, & \text{otherwise} \end{cases}$, where $t \in \mathbb{R}$.

Here, $\lfloor t \rfloor$ represents the largest integer less than or equal to t and $\lceil t \rceil$ denotes the smallest integer greater than or equal to t. The coefficient of the second harmonic component of the Fourier series representing $g(t)$ is _____

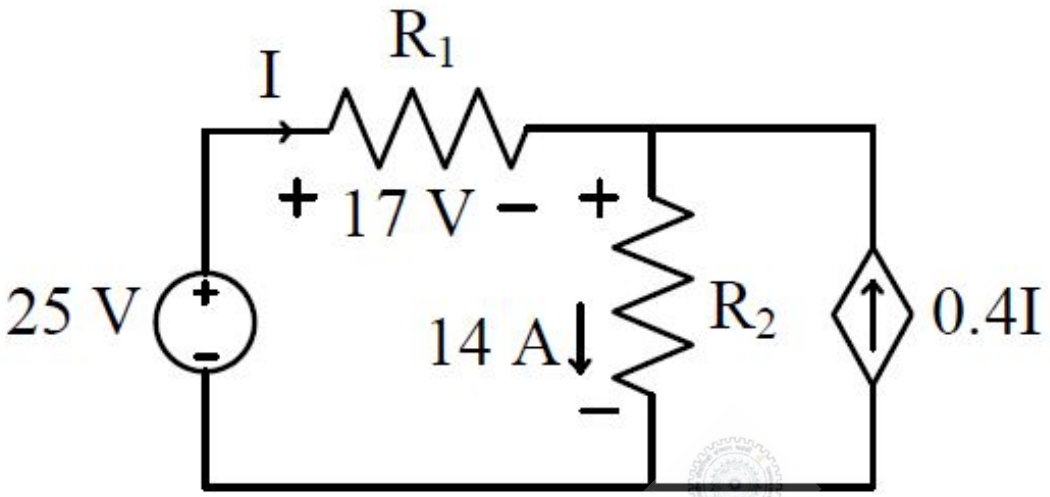
Question Number : 17 Correct : 1 Wrong : 0

Let $I = c \iint_R xy^2 \, dxdy$, where R is the region shown in the figure and $c = 6 \times 10^{-4}$. The value of I equals _____. (Give the answer up to two decimal places.)



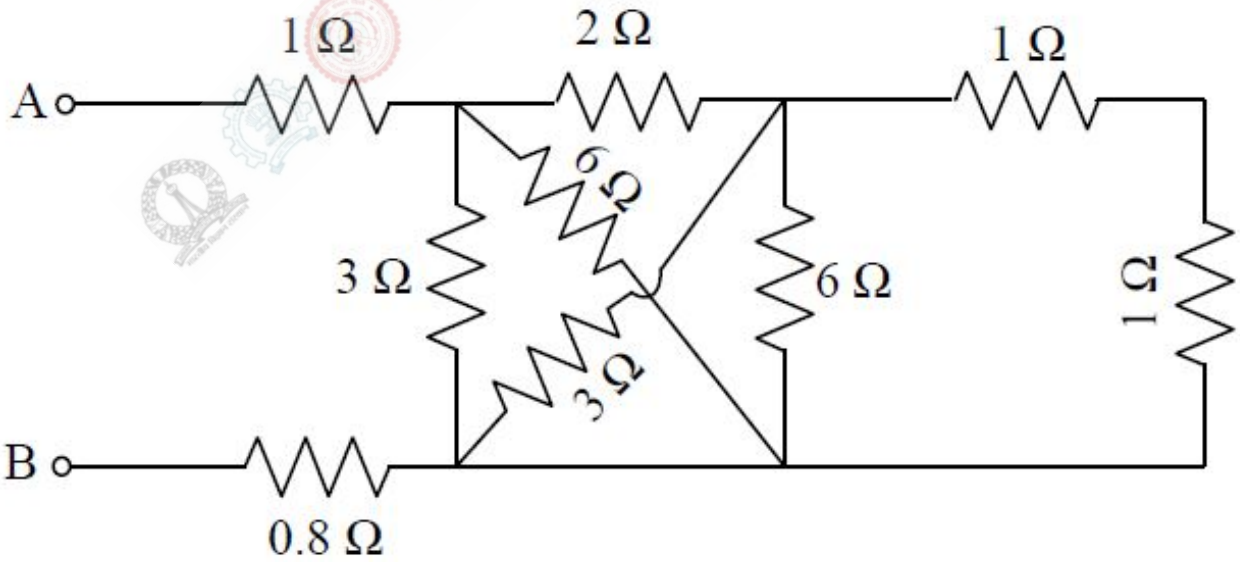
Question Number : 18 **Correct : 1 Wrong : 0**

The power supplied by the 25 V source in the figure shown below is _____ W.



Question Number : 19 **Correct : 1 Wrong : 0**

The equivalent resistance between the terminals A and B is _____ Ω.



Question Number : 20 **Correct : 1 Wrong : 0**

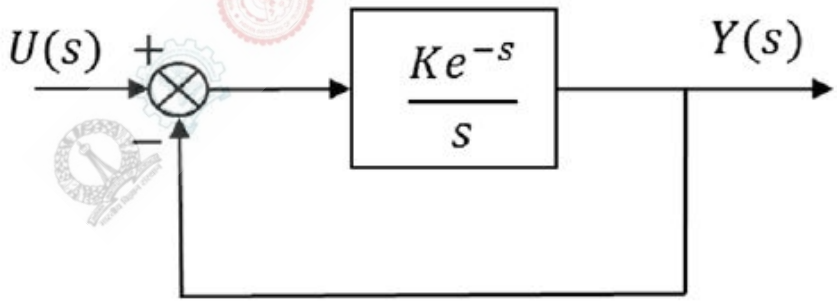
A three-phase, 50Hz, star-connected cylindrical-rotor synchronous machine is running as a motor. The machine is operated from a 6.6 kV grid and draws current at unity power factor (UPF). The synchronous reactance of the motor is 30 Ω per phase. The load angle is 30°. The power delivered to the motor in kW is _____. (Give the answer up to one decimal place).

Question Number : 21 **Correct : 1 Wrong : 0**

A 10-bus power system consists of four generator buses indexed as G1, G2, G3, G4 and six load buses indexed as L1, L2, L3, L4, L5, L6. The generator-bus G1 is considered as slack bus, and the load buses L3 and L4 are voltage controlled buses. The generator at bus G2 cannot supply the required reactive power demand, and hence it is operating at its maximum reactive power limit. The number of non-linear equations required for solving the load flow problem using Newton-Raphson method in polar form is _____.

Question Number : 22 **Correct : 1 Wrong : 0**

Consider the unity feedback control system shown. The value of K that results in a phase margin of the system to be 30° is _____. (Give the answer up to two decimal places.)

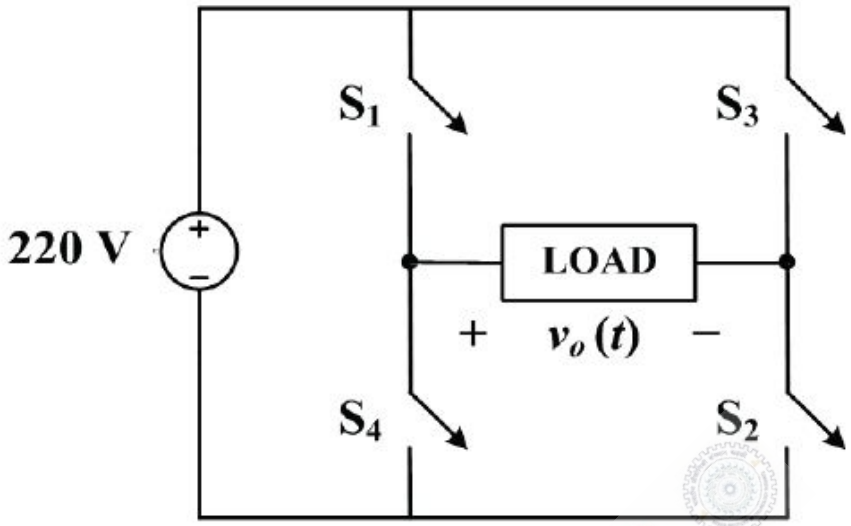


Question Number : 23 **Correct : 1 Wrong : 0**

The following measurements are obtained on a single phase load: V = 220 V ±1 %, I = 5.0 A ± 1% and W = 555 W ± 2 %. If the power factor is calculated using these measurements, the worst case error in the calculated power factor in percent is _____. (Give answer up to one decimal place.)

Question Number : 24 **Correct : 1 Wrong : 0**

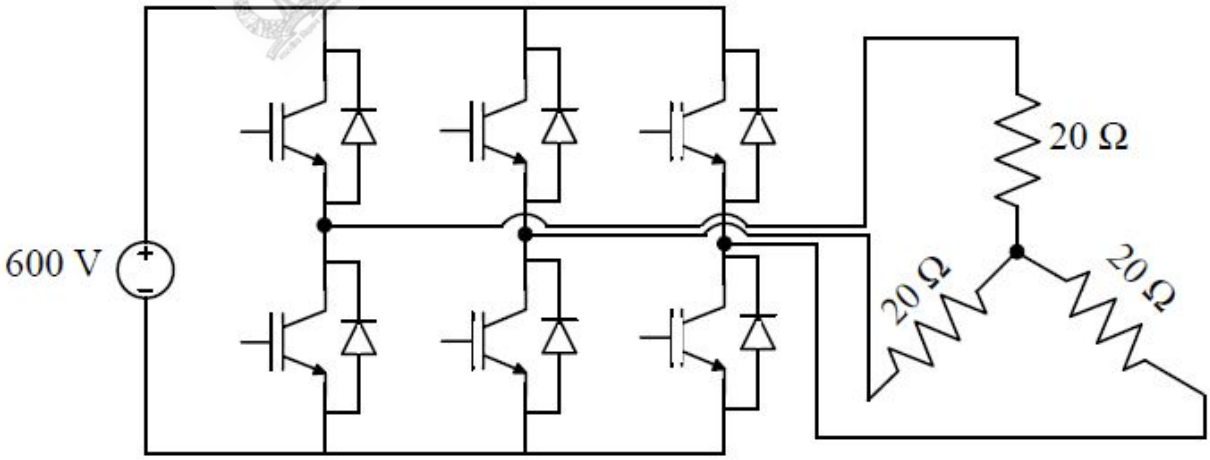
In the converter circuit shown below, the switches are controlled such that the load voltage $v_o(t)$ is a 400 Hz square wave.



The RMS value of the fundamental component of $v_o(t)$ in volts is _____.

Question Number : 25 **Correct : 1 Wrong : 0**

A 3-phase voltage source inverter is supplied from a 600V DC source as shown in the figure below. For a star connected resistive load of 20Ω per phase, the load power for 120° device conduction, in kW, is _____.



Question Number : 26 **Correct : 2 Wrong : -0.66**

A function $f(x)$ is defined as $f(x)=\begin{cases} e^x, & x<1 \\ \ln x + ax^2 + bx, & x \geq 1 \end{cases}$, where $x \in \mathbb{R}$. Which one of the following statements is TRUE?

(A) $f(x)$ is **NOT** differentiable at $x=1$ for any values of a and b.
(B) $f(x)$ is differentiable at $x=1$ for the unique values of a and b.
(C) $f(x)$ is differentiable at $x=1$ for all values of a and b such that $a+b=e$.
(D) $f(x)$ is differentiable at $x=1$ for all values of a and b.

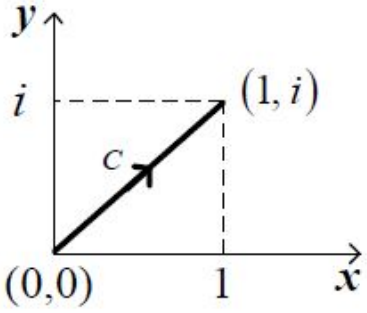
Question Number : 27 **Correct : 2 Wrong : -0.66**

Consider the differential equation $(t^2-81)\frac{dy}{dt}+5t\,y=\sin(t)$ with $y(1)=2\pi$. There exists a unique solution for this differential equation when t belongs to the interval

(A) $(-2, 2)$ (B) $(-10, 10)$ (C) $(-10, 2)$ (D) $(0, 10)$

Question Number : 28 **Correct : 2 Wrong : -0.66**

Consider the line integral $I=\int_C (x^2+iy^2)dz$, where $z=x+iy$. The line C is shown in the figure below.

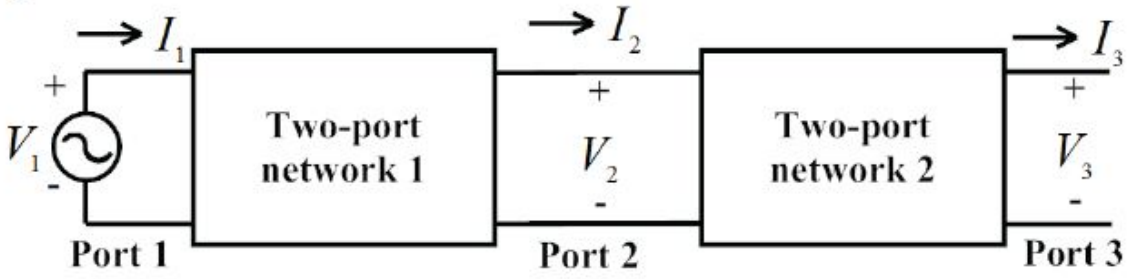


The value of I is

(A) $\frac{1}{2}i$ (B) $\frac{2}{3}i$ (C) $\frac{3}{4}i$ (D) $\frac{4}{5}i$

Question Number : 29 Correct : 2 Wrong : -0.66

Two passive two-port networks are connected in cascade as shown in figure. A voltage source is connected at port 1.



Given

$$V_1 = A_1V_2 + B_1I_2$$
$$I_1 = C_1V_2 + D_1I_2$$
$$V_2 = A_2V_3 + B_2I_3$$
$$I_2 = C_2V_3 + D_2I_3$$

$A_1, B_1, C_1, D_1, A_2, B_2, C_2$, and D_2 are the generalized circuit constants. If the Thevenin equivalent circuit at port 3 consists of a voltage source V_T and an impedance Z_T, connected in series, then

(A) $V_T = \frac{V_1}{A_1A_2}$, $Z_T = \frac{A_1B_2+B_1D_2}{A_1A_2+B_1C_2}$

(B) $V_T = \frac{V_1}{A_1A_2+B_1C_2}$, $Z_T = \frac{A_1B_2+B_1D_2}{A_1A_2}$

(C) $V_T = \frac{V_1}{A_1+A_2}$, $Z_T = \frac{A_1B_2+B_1D_2}{A_1+A_2}$

(D) $V_T = \frac{V_1}{A_1A_2+B_1C_2}$, $Z_T = \frac{A_1B_2+B_1D_2}{A_1A_2+B_1C_2}$

Question Number : 30 Correct : 2 Wrong : -0.66

Let a causal LTI system be characterized by the following differential equation, with initial rest condition

$$\frac{d^2y}{dt^2} + 7\frac{dy}{dt} + 10y(t) = 4x(t) + 5\frac{dx(t)}{dt}$$

where, $x(t)$ and $y(t)$ are the input and output respectively. The impulse response of the system is ($u(t)$ is the unit step function)

(A) $2e^{-2t}u(t) - 7e^{-5t}u(t)$

(B) $-2e^{-2t}u(t) + 7e^{-5t}u(t)$

(C) $7e^{-2t}u(t) - 2e^{-5t}u(t)$

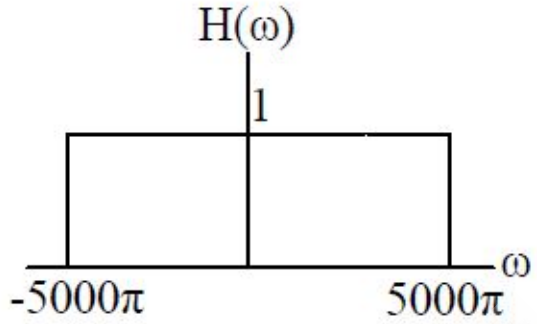
(D) $-7e^{-2t}u(t) + 2e^{-5t}u(t)$

Question Number : 31 **Correct : 2 Wrong : -0.66**

Let the signal

$$x(t) = \sum_{k=-\infty}^{+\infty} (-1)^k \delta\left(t - \frac{k}{2000}\right)$$

be passed through an LTI system with frequency response H(ω), as given in the figure below



The Fourier series representation of the output is given as

(A) $4000 + 4000\cos(2000\pi t) + 4000\cos(4000\pi t)$

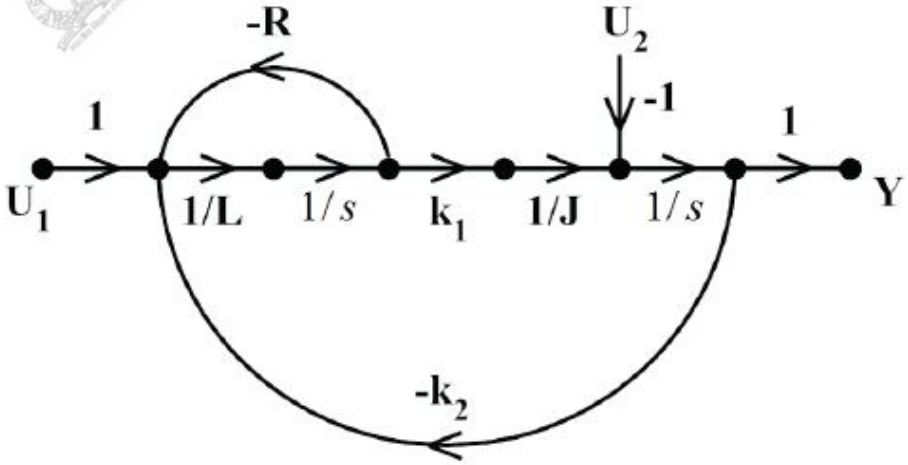
(B) $2000 + 2000\cos(2000\pi t) + 2000\cos(4000\pi t)$

(C) $4000\cos(2000\pi t)$

(D) $2000\cos(2000\pi t)$

Question Number : 32 **Correct : 2 Wrong : -0.66**

In the system whose signal flow graph is shown in the figure, $U_1(s)$ and $U_2(s)$ are inputs. The transfer function $\frac{Y(s)}{U_1(s)}$ is



(A) $\frac{k_1}{JLs^2+JRs+k_1k_2}$

(B) $\frac{k_1}{JLs^2-JRs-k_1k_2}$

(C) $\frac{k_1-U_2(R+sL)}{JLs^2+(JR-U_2L)s+k_1k_2-U_2R}$

(D) $\frac{k_1-U_2(sL-R)}{JLs^2-(JR+U_2L)s-k_1k_2+U_2R}$

Question Number : 33 Correct : 2 Wrong : -0.66

The transfer function of the system Y(s)/U(s) whose state-space equations are given below is:

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}1 & 2\\ 2 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}1\\ 2\end{bmatrix}u(t)$$

$$y(t) = [1\ 0]\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}.$$

(A) $\frac{(s+2)}{(s^2-2s-2)}$

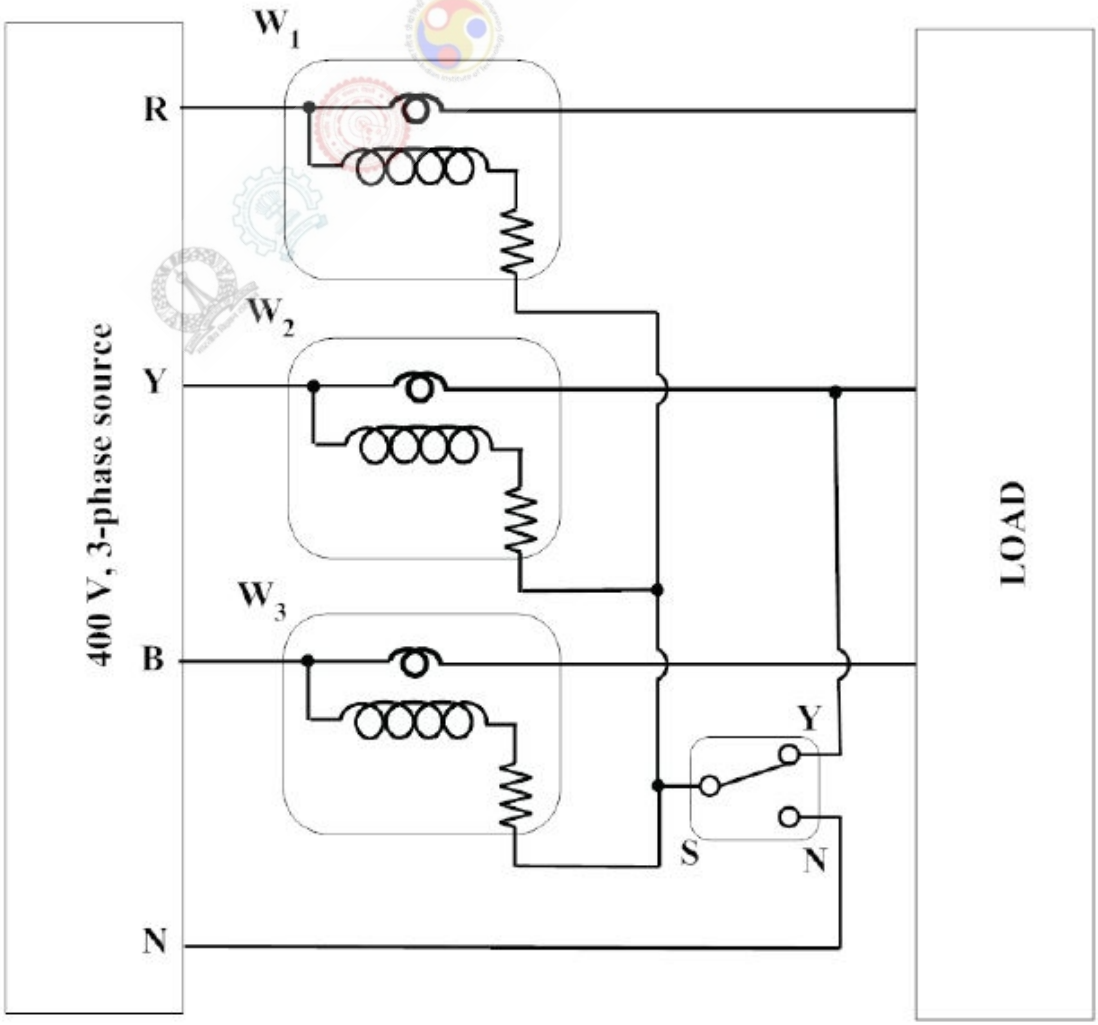
(B) $\frac{(s-2)}{(s^2+s-4)}$

(C) $\frac{(s-4)}{(s^2+s-4)}$

(D) $\frac{(s+4)}{(s^2-s-4)}$

Question Number : 34 Correct : 2 Wrong : -0.66

The load shown in the figure is supplied by a 400 V (line-to-line), 3-phase source (RYB sequence). The load is balanced and inductive, drawing 3464 VA. When the switch S is in position N, the three watt-meters W_1, W_2 and W_3 read 577.35 W each. If the switch is moved to position Y, the readings of the watt-meters in watts will be:

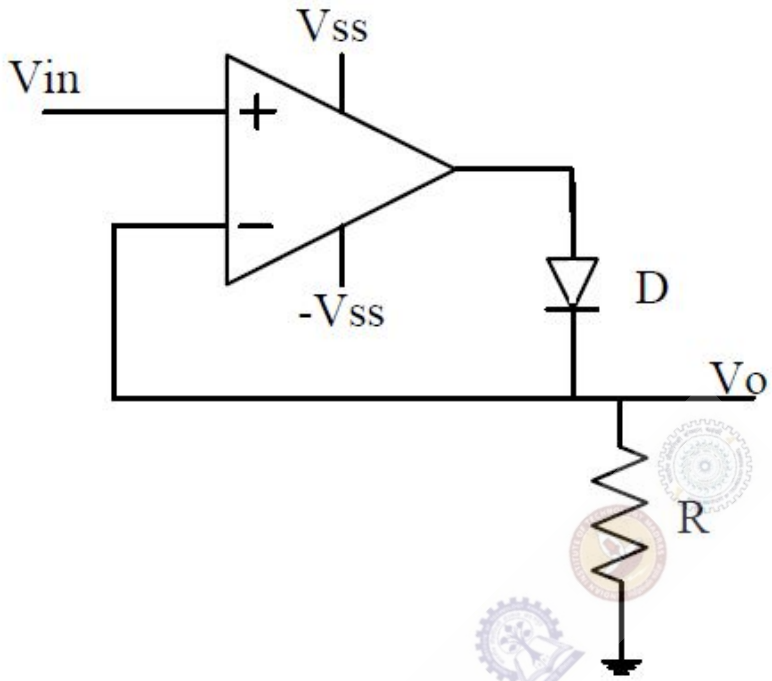


(A) $W_1 = 1732$ and $W_2 = W_3 = 0$

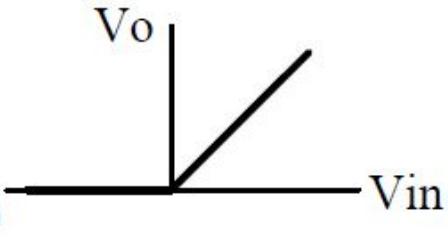
(B) $W_1 = 0$, $W_2 = 1732$ and $W_3 = 0$

Question Number : 35 **Correct : 2 Wrong : -0.66**

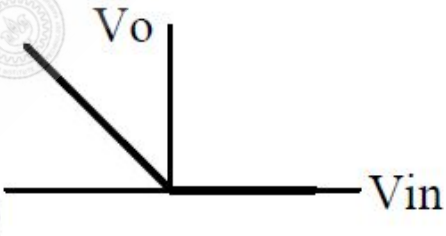
The approximate transfer characteristic for the circuit shown below with an ideal operational amplifier and diode will be



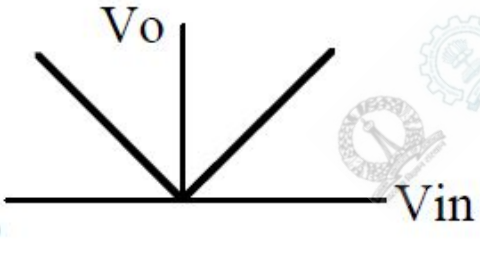
(A)



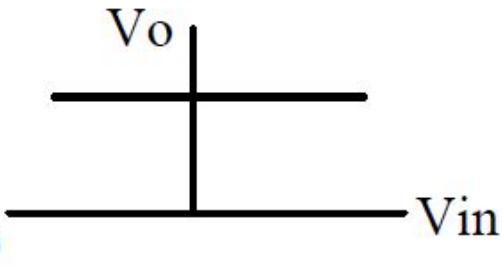
(B)



(C)



(D)



Question Number : 36 **Correct : 2 Wrong : -0.66**

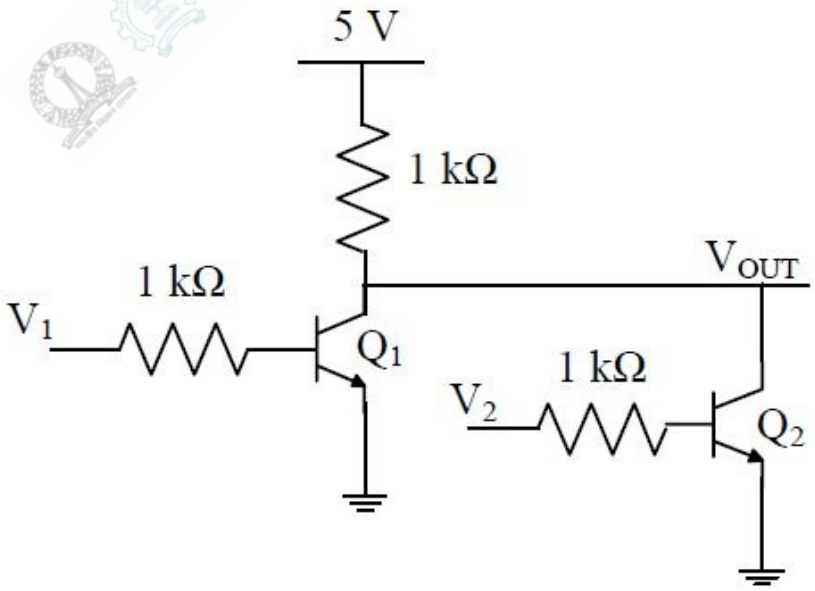
The output expression for the Karnaugh map shown below is

AB \ CD	00	01	11	10
00	0	0	0	0
01	1	0	0	1
11	1	0	1	1
10	0	0	0	0

(A) $B\overline{D} + BCD$
(B) $B\overline{D} + AB$
(C) $\overline{B}D + ABC$
(D) $B\overline{D} + ABC$

Question Number : 37 **Correct : 2 Wrong : -0.66**

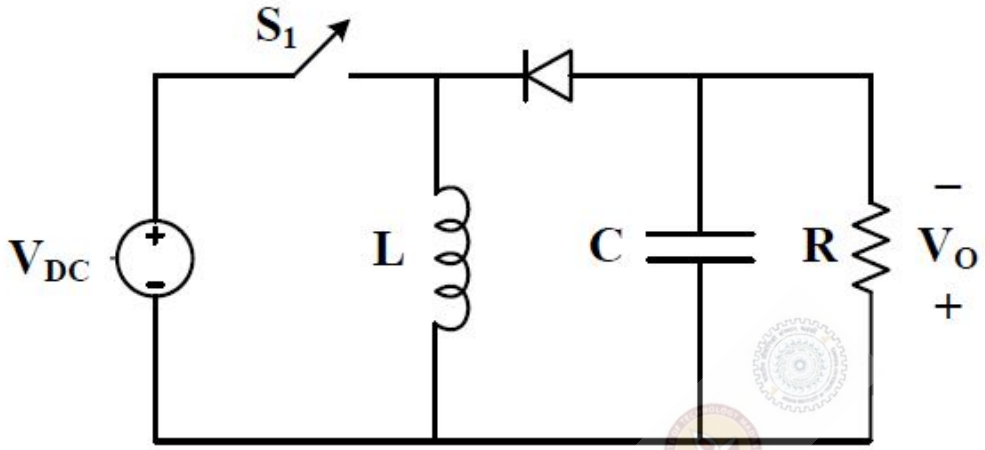
The logical gate implemented using the circuit shown below where, V_1 and V_2 are inputs (with 0 V as digital 0 and 5 V as digital 1) and V_{OUT} is the output, is



(A) NOT (B) NOR (C) NAND (D) XOR

Question Number : 38 Correct : 2 Wrong : -0.66

The input voltage V_{DC} of the buck-boost converter shown below varies from 32 V to 72 V. Assume that all components are ideal, inductor current is continuous, and output voltage is ripple free. The range of duty ratio D of the converter for which the magnitude of the steady-state output voltage remains constant at 48 V is



(A) $\frac{2}{5} \le D \le \frac{3}{5}$ (B) $\frac{2}{3} \le D \le \frac{3}{4}$ (C) $0 \le D \le 1$ (D) $\frac{1}{3} \le D \le \frac{2}{3}$

Question Number : 39 Correct : 2 Wrong : -0.66

A load is supplied by a 230 V, 50 Hz source. The active power P and the reactive power Q consumed by the load are such that $1\,\text{kW} \le P \le 2\,\text{kW}$ and $1\,\text{kVAR} \le Q \le 2\,\text{kVAR}$. A capacitor connected across the load for power factor correction generates 1 kVAR reactive power. The worst case power factor after power factor correction is

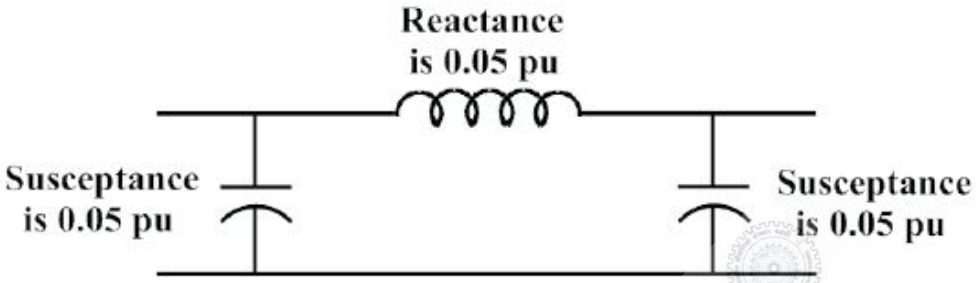
(A) 0.447 lag (B) 0.707 lag (C) 0.894 lag (D) 1

Question Number : 40 Correct : 2 Wrong : -0.66

The bus admittance matrix for a power system network is

$$\begin{bmatrix} -j39.9 & j20 & j20 \\ j20 & -j39.9 & j20 \\ j20 & j20 & -j39.9 \end{bmatrix} \text{pu.}$$

There is a transmission line, connected between buses 1 and 3, which is represented by the circuit shown in figure.



If this transmission line is removed from service, what is the modified bus admittance matrix?

(A) $\begin{bmatrix} -j19.9 & j20 & 0 \\ j20 & -j39.9 & j20 \\ 0 & j20 & -j19.9 \end{bmatrix}$ pu

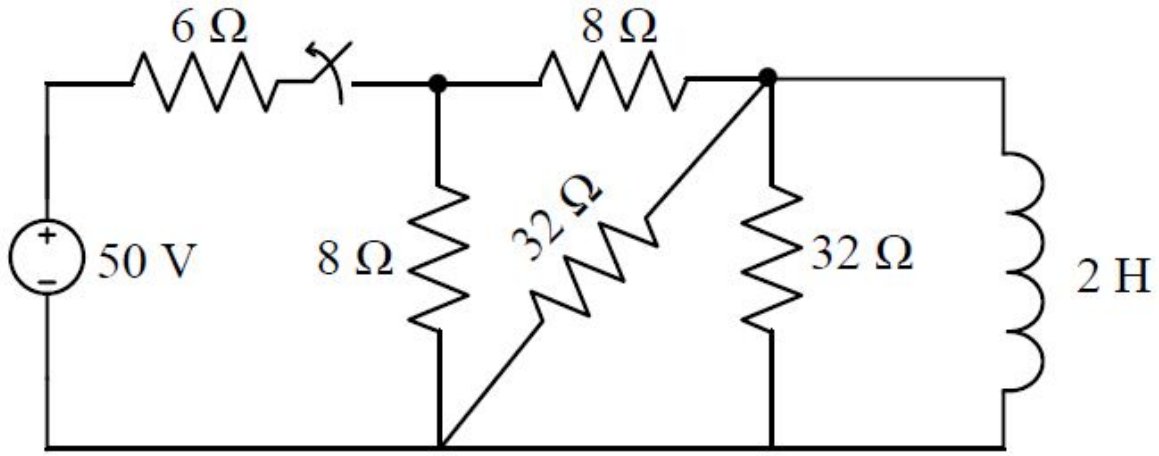
(B) $\begin{bmatrix} -j39.95 & j20 & 0 \\ j20 & -j39.9 & j20 \\ 0 & j20 & -j39.95 \end{bmatrix}$ pu

(C) $\begin{bmatrix} -j19.95 & j20 & 0 \\ j20 & -j39.9 & j20 \\ 0 & j20 & -j19.95 \end{bmatrix}$ pu

(D) $\begin{bmatrix} -j19.95 & j20 & j20 \\ j20 & -j39.9 & j20 \\ j20 & j20 & -j19.95 \end{bmatrix}$ pu

Question Number : 41 Correct : 2 Wrong : -0.66

The switch in the figure below was closed for a long time. It is opened at $t = 0$. The current in the inductor of 2 H for $t \geq 0$, is



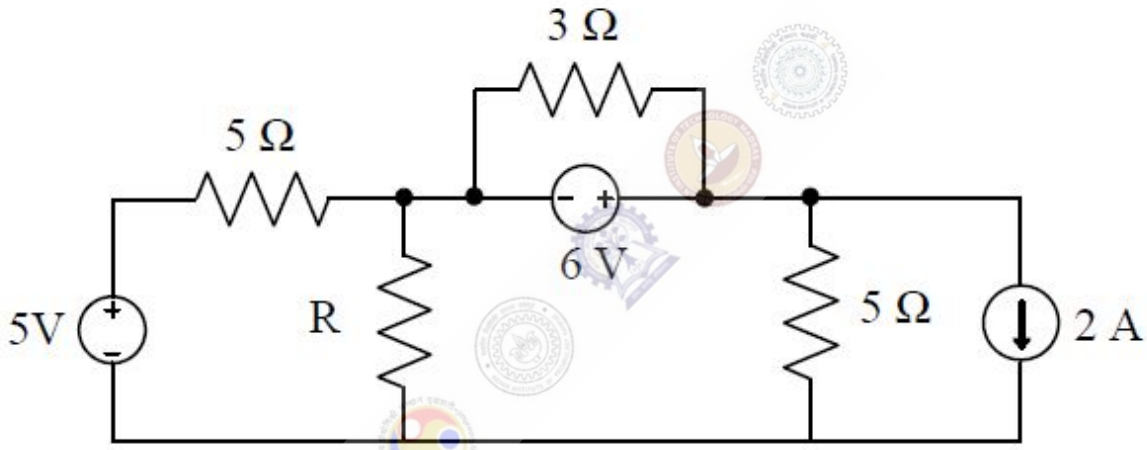
(A) $2.5e^{-4t}$ (B) $5e^{-4t}$ (C) $2.5e^{-0.25t}$ (D) $5e^{-0.25t}$

Question Number : 42 **Correct : 2 Wrong : 0**

Only one of the real roots of $f(x) = x^6 - x - 1$ lies in the interval $1 \le x \le 2$ and bisection method is used to find its value. For achieving an accuracy of 0.001, the required minimum number of iterations is _____.

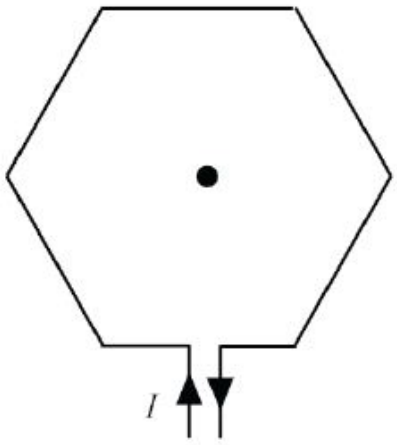
Question Number : 43 **Correct : 2 Wrong : 0**

In the circuit shown below, the maximum power transferred to the resistor R is _____ W.



Question Number : 44 **Correct : 2 Wrong : 0**

The magnitude of magnetic flux density (B) in micro Teslas (μT), at the center of a loop of wire wound as a regular hexagon of side length 1 m carrying a current (I=1 A), and placed in vacuum as shown in the figure is _____. (Give the answer up to two decimal places.)



Question Number : 45 **Correct : 2 Wrong : 0**

A 375 W, 230 V, 50 Hz, capacitor start single-phase induction motor has the following constants for the main and auxiliary windings (at starting): $Z_m = (12.50 + j15.75)\ \Omega$ (main winding), $Z_a = (24.50 + j12.75)\ \Omega$ (auxiliary winding). Neglecting the magnetizing branch, the value of the capacitance (in μF) to be added in series with the auxiliary winding to obtain maximum torque at starting is _____.

Question Number : 46 **Correct : 2 Wrong : 0**

Two parallel connected, three-phase, 50Hz, 11 kV, star-connected synchronous machines A and B, are operating as synchronous condensers. They together supply 50 MVAR to a 11 kV grid. Current supplied by both the machines are equal. Synchronous reactances of machine A and machine B are 1Ω and 3Ω, respectively. Assuming the magnetic circuit to be linear, the ratio of excitation current of machine A to that of machine B is _____. (Give the answer up to two decimal places.)

Question Number : 47 **Correct : 2 Wrong : 0**

A 220 V DC series motor runs drawing a current of 30 A from the supply. Armature and field circuit resistances are 0.4 Ω and 0.1 Ω, respectively. The load torque varies as the square of the speed. The flux in the motor may be taken as being proportional to the armature current. To reduce the speed of the motor by 50%, the resistance in ohms that should be added in series with the armature is _____. (Give the answer up to two decimal places.)

Question Number : 48 **Correct : 2 Wrong : 0**

A three-phase, three winding Δ/Δ/Y (1.1 kV/6.6 kV/400 V) transformer is energized from AC mains at the 1.1 kV side. It supplies 900 kVA load at 0.8 power factor lag from the 6.6 kV winding and 300 kVA load at 0.6 power factor lag from the 400 V winding. The RMS line current in ampere drawn by the 1.1 kV winding from the mains is _____. (Give the answer up to one decimal place.)

Question Number : 49 **Correct : 2 Wrong : 0**

A separately excited DC generator supplies 150 A to a 145 V DC grid. The generator is running at 800 RPM. The armature resistance of the generator is 0.1Ω. If the speed of the generator is increased to 1000 RPM, the current in amperes supplied by the generator to the DC grid is _____. (Give the answer up to one decimal place.)

Question Number : 50 **Correct : 2 Wrong : 0**

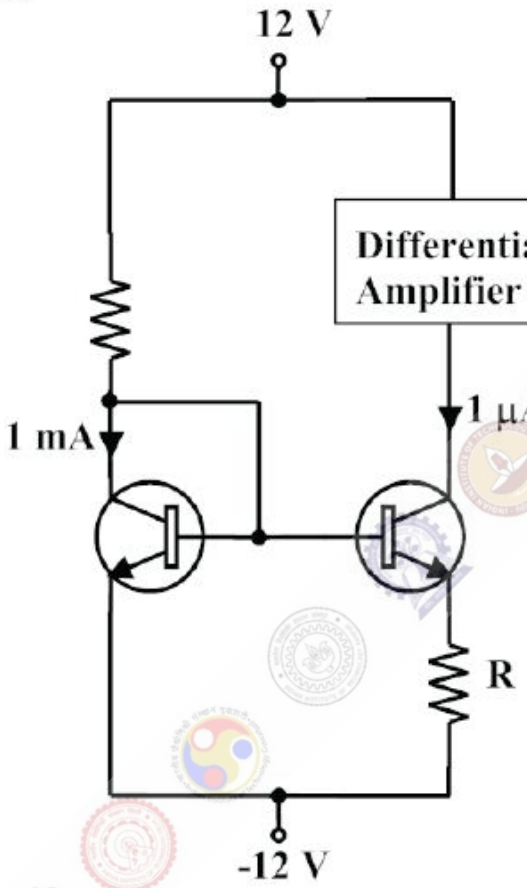
For a system having transfer function $G(s)=\frac{-s+1}{s+1}$, a unit step input is applied at time $t=0$. The value of the response of the system at $t=1.5$ sec (rounded off to three decimal places) is _____

Question Number : 51 **Correct : 2 Wrong : 0**

Consider a causal and stable LTI system with rational transfer function $H(z)$, whose corresponding impulse response begins at $n=0$. Furthermore, $H(1)=\frac{5}{4}$. The poles of $H(z)$ are $p_k=\frac{1}{\sqrt{2}}\exp(j\frac{(2k-1)\pi}{4})$ for $k=1,2,3,4$. The zeros of $H(z)$ are all at $z=0$. Let $g[n]=j^n h[n]$. The value of $g[8]$ equals _____. (Give the answer up to three decimal places.)

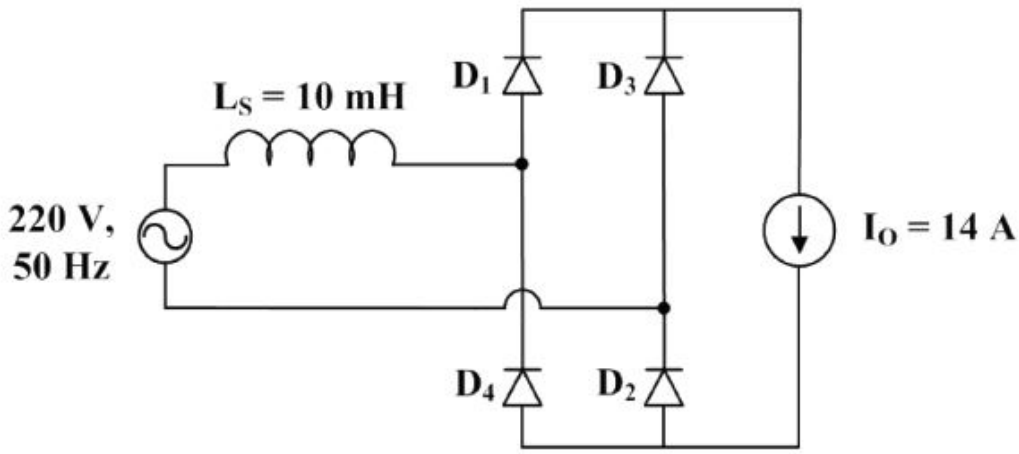
Question Number : 52 **Correct : 2 Wrong : 0**

The circuit shown in the figure uses matched transistors with a thermal voltage $V_T = 25$ mV. The base currents of the transistors are negligible. The value of the resistance R in $k\Omega$ that is required to provide 1 μA bias current for the differential amplifier block shown is _____. (Give the answer up to one decimal place.)



Question Number : 53 **Correct : 2 Wrong : 0**

The figure below shows an uncontrolled diode bridge rectifier supplied from a 220 V, 50 Hz, 1-phase ac source. The load draws a constant current $I_o = 14$ A. The conduction angle of the diode D_1 in degrees (rounded off to two decimal places) is _____.

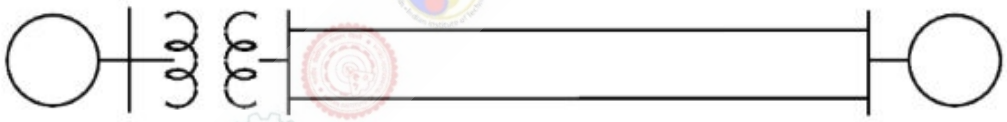


Question Number : 54 Correct : 2 Wrong : 0

The positive, negative, and zero sequence reactances of a wye-connected synchronous generator are 0.2 pu, 0.2 pu, and 0.1 pu, respectively. The generator is on open circuit with a terminal voltage of 1 pu. The minimum value of the inductive reactance, in pu, required to be connected between neutral and ground so that the fault current does not exceed 3.75 pu if a single line to ground fault occurs at the terminals is _____ (assume fault impedance to be zero). (Give the answer up to one decimal place.)

Question Number : 55 Correct : 2 Wrong : 0

The figure shows the single line diagram of a power system with a double circuit transmission line. The expression for electrical power is $1.5 \sin \delta$, where δ is the rotor angle. The system is operating at the stable equilibrium point with mechanical power equal to 1 pu. If one of the transmission line circuits is removed, the maximum value of δ, as the rotor swings, is 1.221 radian. If the expression for electrical power with one transmission line circuit removed is $P_{max} \sin \delta$, the value of P_{max}, in pu is _____. (Give the answer up to three decimal places.)



Question Number : 56 **Correct : 1 Wrong : -0.33**

After Rajendra Chola returned from his voyage to Indonesia, he _____ to visit the temple in Thanjavur.

(A) was wishing (B) is wishing (C) wished (D) had wished

Question Number : 57 **Correct : 1 Wrong : -0.33**

Research in the workplace reveals that people work for many reasons _____.

(A) money beside (B) beside money (C) money besides (D) besides money

Question Number : 58 **Correct : 1 Wrong : -0.33**

Rahul, Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?

(A) Rahul and Murali
(B) Srinivas and Arul
(C) Srinivas and Murali
(D) Srinivas and Rahul

Question Number : 59 **Correct : 1 Wrong : -0.33**

Find the smallest number y such that $y \times 162$ is a perfect cube.

(A) 24 (B) 27 (C) 32 (D) 36

Question Number : 60 **Correct : 1 Wrong : -0.33**

The probability that a k-digit number does NOT contain the digits 0, 5, or 9 is

(A) 0.3^k (B) 0.6^k (C) 0.7^k (D) 0.9^k

Question Number : 61 Correct : 2 Wrong : -0.66

"The hold of the nationalist imagination on our colonial past is such that anything inadequately or improperly nationalist is just not history."

Which of the following statements best reflects the author's opinion?

(A) Nationalists are highly imaginative.
(B) History is viewed through the filter of nationalism.
(C) Our colonial past never happened.
(D) Nationalism has to be both adequately and properly imagined.

Question Number : 62 Correct : 2 Wrong : -0.66

Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is

(A) 2 (B) 3 (C) 4 (D) Cannot be determined

Question Number : 63 Correct : 2 Wrong : -0.66

The expression $\frac{(x+y)-|x-y|}{2}$ is equal to

(A) the maximum of x and y
(B) the minimum of x and y
(C) 1
(D) none of the above

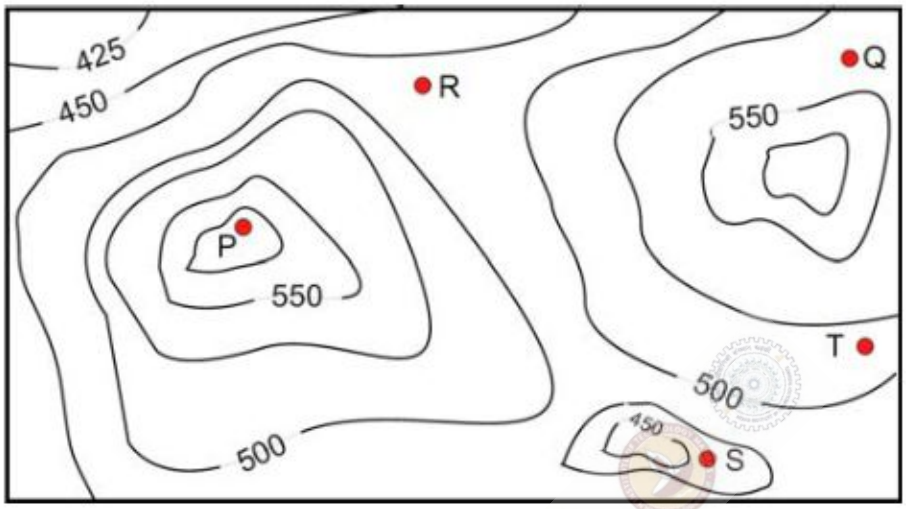
Question Number : 64 Correct : 2 Wrong : -0.66

Arun, Gulab, Neel and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?

(A) 21 (B) 18 (C) 16 (D) 14

Question Number : 65 **Correct : 2 Wrong : 0.66**

A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. If in a flood, the water level rises to 525 m, which of the villages P, Q, R, S, T get submerged?



(A) P, Q (B) P, Q, T (C) R, S, T (D) Q, R, S

Q. No.	Type	Section	Key	Marks
1	MCQ	EE-1	C	1
2	MCQ	EE-1	D	1
3	MCQ	EE-1	A	1
4	MCQ	EE-1	A	1
5	MCQ	EE-1	D	1
6	MCQ	EE-1	D	1
7	MCQ	EE-1	D	1
8	MCQ	EE-1	C	1
9	MCQ	EE-1	A	1
10	MCQ	EE-1	B	1
11	MCQ	EE-1	D	1
12	MCQ	EE-1	A	1
13	MCQ	EE-1	A	1
14	MCQ	EE-1	B	1
15	MCQ	EE-1	D	1
16	NAT	EE-1	Mark to all	1
17	NAT	EE-1	0.99 to 1.01	1
18	NAT	EE-1	248 to 252	1
19	NAT	EE-1	2.9 to 3.1	1
20	NAT	EE-1	835 to 842	1
21	NAT	EE-1	14 to 14	1
22	NAT	EE-1	1.01 to 1.06	1
23	NAT	EE-1	4 to 4.1	1
24	NAT	EE-1	196 to 200	1
25	NAT	EE-1	8.5 to 9.5	1
26	MCQ	EE-1	B	2
27	MCQ	EE-1	A	2
28	MCQ	EE-1	B	2
29	MCQ	EE-1	D	2
30	MCQ	EE-1	B	2
31	MCQ	EE-1	C	2
32	MCQ	EE-1	A	2
33	MCQ	EE-1	D	2
34	MCQ	EE-1	D	2
35	MCQ	EE-1	A	2
36	MCQ	EE-1	D	2

37	MCQ	EE-1	B	2
38	MCQ	EE-1	A	2
39	MCQ	EE-1	B	2
40	MCQ	EE-1	C	2
41	MCQ	EE-1	A	2
42	NAT	EE-1	10 to 10	2
43	NAT	EE-1	3 to 3.1	2
44	NAT	EE-1	0.65 to 0.75	2
45	NAT	EE-1	145 to 155	2
46	NAT	EE-1	0.7 to 0.79	2
47	NAT	EE-1	9.5 to 12	2
48	NAT	EE-1	620 to 630	2
49	NAT	EE-1	548 to 552	2
50	NAT	EE-1	0.550 to 0.556	2
51	NAT	EE-1	0.09 to 0.1	2
52	NAT	EE-1	170 to 174	2
53	NAT	EE-1	220 to 230	2
54	NAT	EE-1	0.1 to 0.1	2
55	NAT	EE-1	1.20 to 1.24	2
56	MCQ	GA	C	1
57	MCQ	GA	D	1
58	MCQ	GA	C	1
59	MCQ	GA	D	1
60	MCQ	GA	C	1
61	MCQ	GA	B	2
62	MCQ	GA	A	2
63	MCQ	GA	B	2
64	MCQ	GA	D	2
65	MCQ	GA	C	2

Graduate Aptitude Test in Engineering 2017

Question Paper Name: Electrical Engineering 11th Feb 2017 session 2
Subject Name: Electrical Engineering
Duration: 180
Total Marks: 100

Organizing Institute:

Indian Institute of Technology Roorkee

Question Number : 1 **Correct : 1 Wrong : -0.33**

An urn contains 5 red balls and 5 black balls. In the first draw, one ball is picked at random and discarded without noticing its colour. The probability to get a red ball in the second draw is

(A) $\frac{1}{2}$ (B) $\frac{4}{9}$ (C) $\frac{5}{9}$ (D) $\frac{6}{9}$

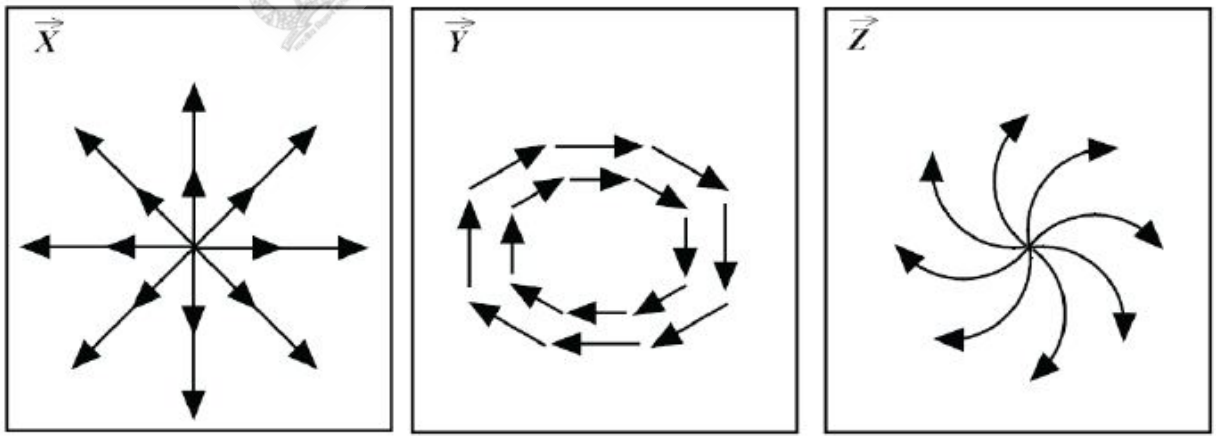
Question Number : 2 **Correct : 1 Wrong : -0.33**

Consider a solid sphere of radius 5 cm made of a perfect electric conductor. If one million electrons are added to this sphere, these electrons will be distributed

(A) uniformly over the entire volume of the sphere
(B) uniformly over the outer surface of the sphere
(C) concentrated around the centre of the sphere
(D) along a straight line passing through the centre of the sphere

Question Number : 3 **Correct : 1 Wrong : -0.33**

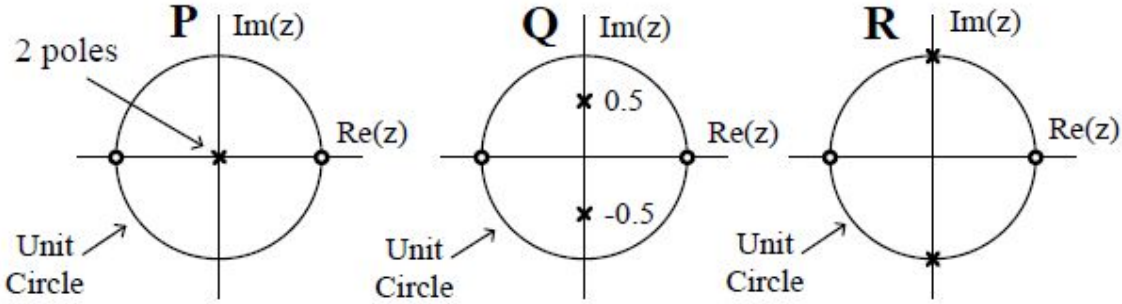
The figures show diagramatic representations of vector fields $\vec{X}$, $\vec{Y}$, and $\vec{Z}$, respectively. Which one of the following choices is true?



(A) $\nabla.\vec{X}=0, \nabla\times\vec{Y}\neq 0, \nabla\times\vec{Z}=0$
(B) $\nabla.\vec{X}\neq 0, \nabla\times\vec{Y}=0, \nabla\times\vec{Z}\neq 0$
(C) $\nabla.\vec{X}\neq 0, \nabla\times\vec{Y}\neq 0, \nabla\times\vec{Z}\neq 0$
(D) $\nabla.\vec{X}=0, \nabla\times\vec{Y}=0, \nabla\times\vec{Z}=0$

Question Number : 4 **Correct : 1 Wrong : -0.33**

The pole-zero plots of three discrete-time systems **P**, **Q** and **R** on the z-plane are shown below.



Which one of the following is TRUE about the frequency selectivity of these systems?

(A) All three are high-pass filters.
(B) All three are band-pass filters.
(C) All three are low-pass filters.
(D) **P** is a low-pass filter, **Q** is a band-pass filter and **R** is a high-pass filter.

Question Number : 5 **Correct : 1 Wrong : -0.33**

If a synchronous motor is running at a leading power factor, its excitation induced voltage (E_f) is

(A) equal to terminal voltage V_t
(B) higher than the terminal voltage V_t
(C) less than terminal voltage V_t
(D) dependent upon supply voltage V_t

Question Number : 6 **Correct : 1 Wrong : -0.33**

When a unit ramp input is applied to the unity feedback system having closed loop transfer function $\frac{C(s)}{R(s)} = \frac{Ks+b}{s^2+as+b}$, $(a>0, b>0, K>0)$, the steady state error will be

(A) 0 (B) $\frac{a}{b}$ (C) $\frac{a+K}{b}$ (D) $\frac{a-K}{b}$

Question Number : 7 Correct : 1 Wrong : -0.33

The transfer function $C(s)$ of a compensator is given below.

$$C(s) = \frac{\left(1+\frac{s}{0.1}\right)\left(1+\frac{s}{100}\right)}{(1+s)\left(1+\frac{s}{10}\right)}$$

The frequency range in which the phase (lead) introduced by the compensator reaches the maximum is

(A) $0.1 < \omega < 1$ (B) $1 < \omega < 10$ (C) $10 < \omega < 100$ (D) $\omega > 100$

Question Number : 8 Correct : 1 Wrong : -0.33

Two resistors with nominal resistance values R_1 and R_2 have additive uncertainties ΔR_1 and ΔR_2, respectively. When these resistances are connected in parallel, the standard deviation of the error in the equivalent resistance R is

(A) $\pm\sqrt{\left\{\frac{\partial R}{\partial R_1}\Delta R_1\right\}^2+\left\{\frac{\partial R}{\partial R_2}\Delta R_2\right\}^2}$ (B) $\pm\sqrt{\left\{\frac{\partial R}{\partial R_2}\Delta R_1\right\}^2+\left\{\frac{\partial R}{\partial R_1}\Delta R_2\right\}^2}$

(C) $\pm\sqrt{\left\{\frac{\partial R}{\partial R_1}\right\}^2\Delta R_2+\left\{\frac{\partial R}{\partial R_2}\right\}^2\Delta R_1}$ (D) $\pm\sqrt{\left\{\frac{\partial R}{\partial R_1}\right\}^2\Delta R_1+\left\{\frac{\partial R}{\partial R_2}\right\}^2\Delta R_2}$

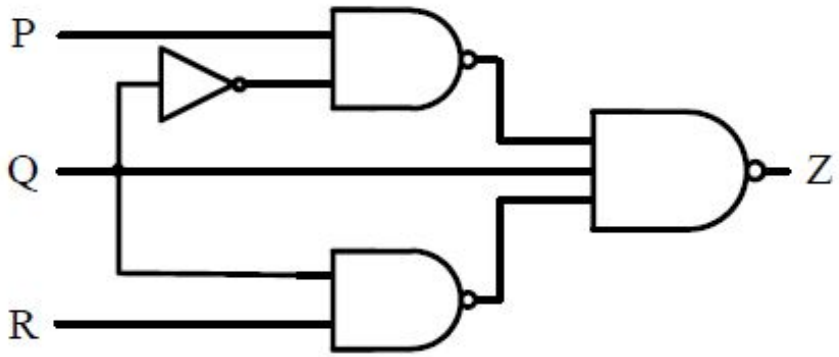
Question Number : 9 Correct : 1 Wrong : -0.33

A stationary closed Lissajous pattern on an oscilloscope has 3 horizontal tangencies and 2 vertical tangencies for a horizontal input with frequency 3 kHz. The frequency of the vertical input is

(A) 1.5 kHz (B) 2 kHz (C) 3 kHz (D) 4.5 kHz

Question Number : 10 **Correct : 1 Wrong : -0.33**

For a 3-input logic circuit shown below, the output Z can be expressed as



(A) $Q+\overline{R}$

(B) $P\overline{Q}+R$

(C) $\overline{Q}+R$

(D) $P+\overline{Q}+R$

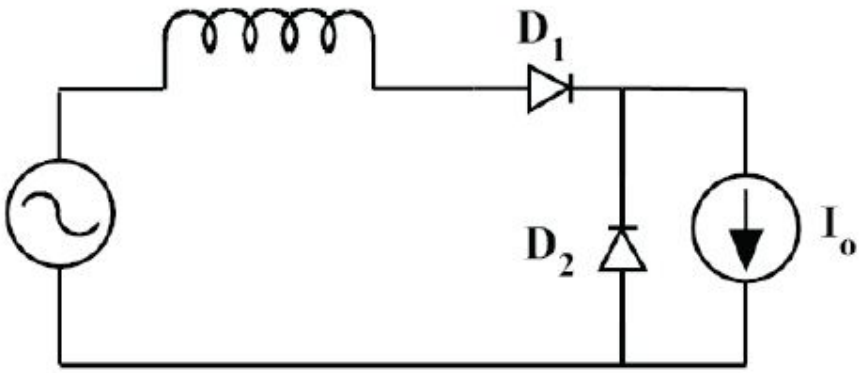
Question Number : 11 **Correct : 1 Wrong : -0.33**

A phase-controlled, single-phase, full-bridge converter is supplying a highly inductive DC load. The converter is fed from a 230 V, 50 Hz, AC source. The fundamental frequency in Hz of the voltage ripple on the DC side is

(A) 25 (B) 50 (C) 100 (D) 300

Question Number : 12 **Correct : 1 Wrong : -0.33**

In the circuit shown, the diodes are ideal, the inductance is small, and $I_0 \neq 0$. Which one of the following statements is true?



(A) D_1 conducts for greater than 180° and D_2 conducts for greater than 180°.
(B) D_2 conducts for more than 180° and D_1 conducts for 180°.
(C) D_1 conducts for 180° and D_2 conducts for 180°.
(D) D_1 conducts for more than 180° and D_2 conducts for 180°.

Question Number : 13 Correct : 1 Wrong : -0.33

A three-phase voltage source inverter with ideal devices operating in 180° conduction mode is feeding a balanced star-connected resistive load. The DC voltage input is V_{dc}. The peak of the fundamental component of the phase voltage is

(A) $\frac{V_{dc}}{\pi}$ (B) $\frac{2V_{dc}}{\pi}$ (C) $\frac{3V_{dc}}{\pi}$ (D) $\frac{4V_{dc}}{\pi}$

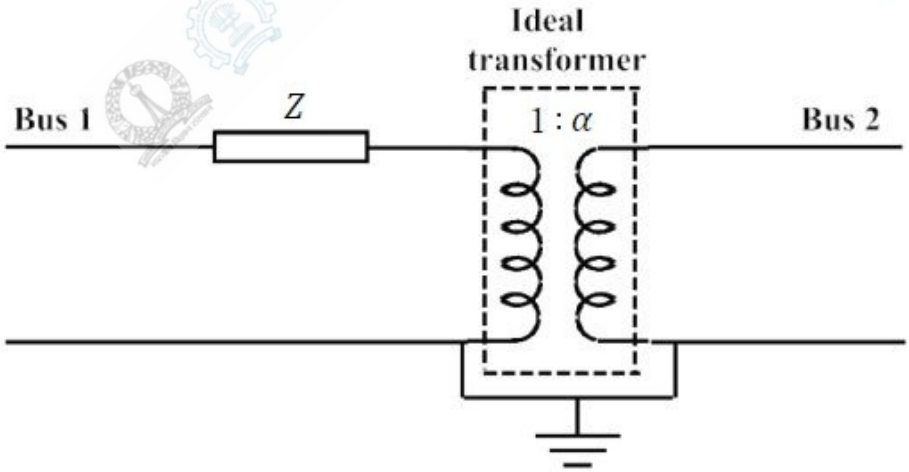
Question Number : 14 Correct : 1 Wrong : -0.33

A 3-phase, 4-pole, 400 V, 50 Hz squirrel-cage induction motor is operating at a slip of 0.02. The speed of the rotor flux in mechanical rad/sec, sensed by a stationary observer, is closest to

(A) 1500
(B) 1470
(C) 157
(D) 154

Question Number : 15 Correct : 1 Wrong : -0.33

The figure shows the per-phase representation of a phase-shifting transformer connected between buses 1 and 2, where α is a complex number with non-zero real and imaginary parts.

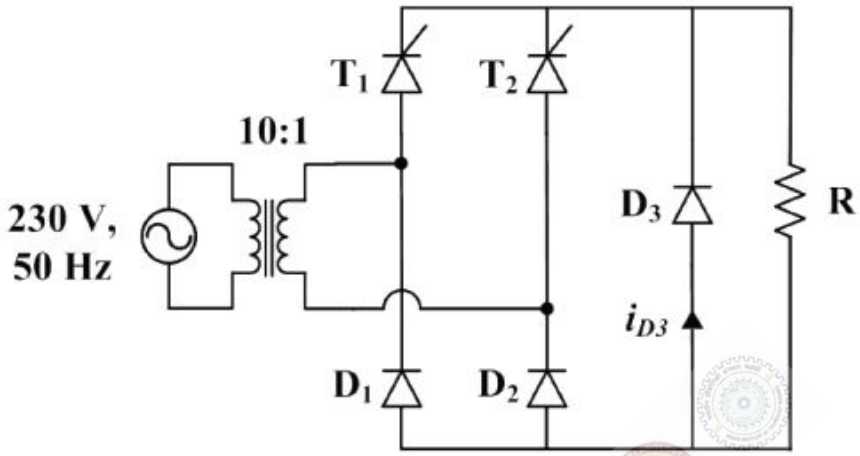


For the given circuit, Y_{bus} and Z_{bus} are bus admittance matrix and bus impedance matrix, respectively, each of size 2×2. Which one of the following statements is true?

(A) Both Y_{bus} and Z_{bus} are symmetric
(B) Y_{bus} is symmetric and Z_{bus} is unsymmetric
(C) Y_{bus} is unsymmetric and Z_{bus} is symmetric
(D) Both Y_{bus} and Z_{bus} are unsymmetric

Question Number : 16 Correct : 1 Wrong : 0

The figure below shows the circuit diagram of a controlled rectifier supplied from a 230 V, 50 Hz, 1-phase voltage source and a 10:1 ideal transformer. Assume that all devices are ideal. The firing angles of the thyristors T_1 and T_2 are 90° and 270°, respectively.



The RMS value of the current through diode D_3 in amperes is _____

Question Number : 17 Correct : 1 Wrong : 0

Assume that in a traffic junction, the cycle of the traffic signal lights is 2 minutes of green (vehicle does not stop) and 3 minutes of red (vehicle stops). Consider that the arrival time of vehicles at the junction is uniformly distributed over 5 minute cycle. The expected waiting time (in minutes) for the vehicle at the junction is _____

Question Number : 18 Correct : 1 Wrong : 0

Consider a function *f(x,y,z)* given by

$$f(x,y,z) = (x^2 + y^2 - 2z^2)(y^2 + z^2)$$

The partial derivative of this function with respect to x at the point $x = 2$, $y = 1$ and $z = 3$ is _____.

Question Number : 19 **Correct : 1 Wrong : 0**

Let x and y be integers satisfying the following equations

$$2x^2 + y^2 = 34$$
$$x + 2y = 11$$

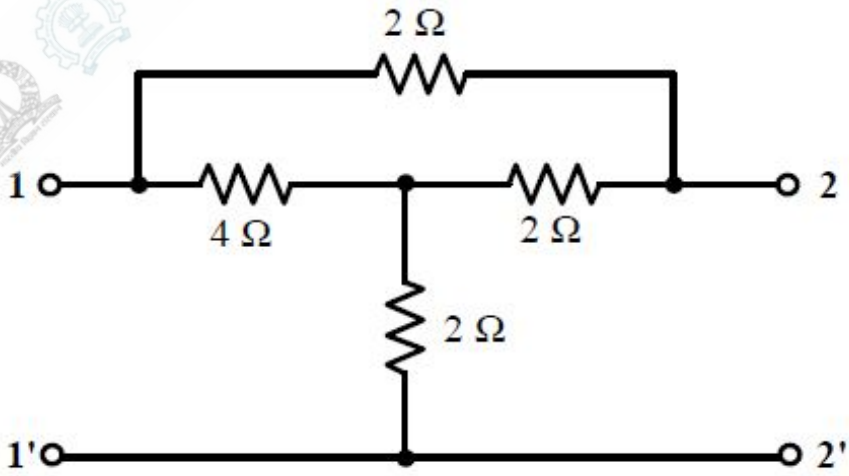
The value of $(x + y)$ is _____.

Question Number : 20 **Correct : 1 Wrong : 0**

Let $y^2 - 2y + 1 = x$ and $\sqrt{x} + y = 5$. The value of $x + \sqrt{y}$ equals _____. (Give the answer up to three decimal places)

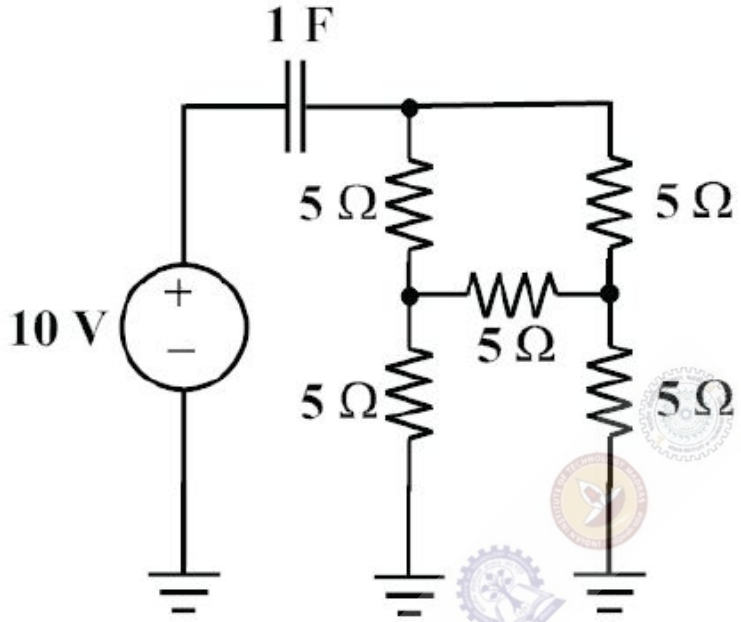
Question Number : 21 **Correct : 1 Wrong : 0**

For the given 2-port network, the value of transfer impedance z_{21} in ohms is _____



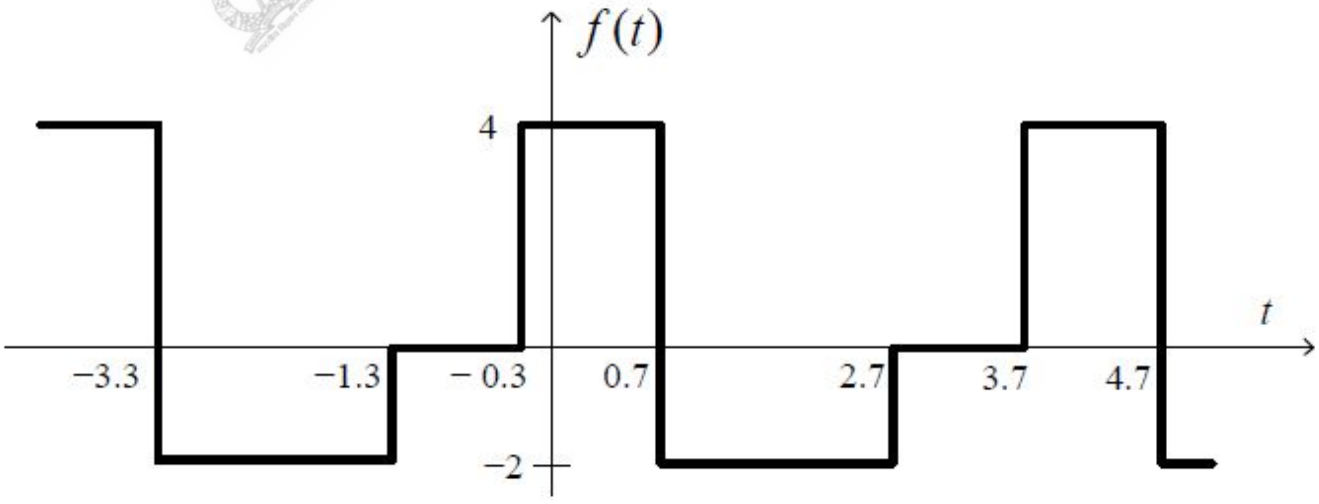
Question Number : 22 **Correct : 1 Wrong : 0**

The initial charge in the 1 F capacitor present in the circuit shown is zero. The energy in joules transferred from the DC source until steady state condition is reached equals _____. (Give the answer up to one decimal place.)



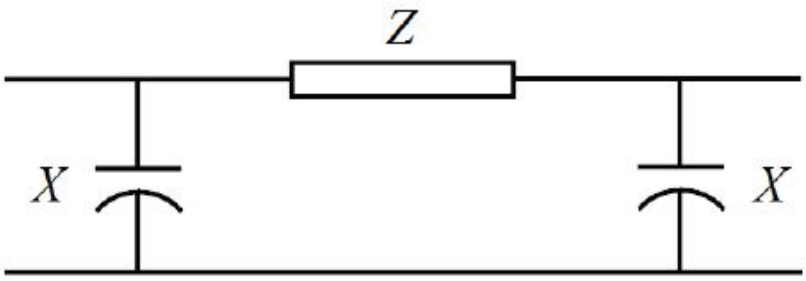
Question Number : 23 **Correct : 1 Wrong : 0**

The mean square value of the given periodic waveform $f(t)$ is _____



Question Number : 24 **Correct : 1 Wrong : 0**

The nominal-π circuit of a transmission line is shown in the figure.



Impedance $Z = 100\angle 80°\ \Omega$ and reactance $X = 3300\ \Omega$. The magnitude of the characteristic impedance of the transmission line, in Ω, is _____. (Give the answer up to one decimal place.)

Question Number : 25 **Correct : 1 Wrong : 0**

In a load flow problem solved by Newton-Raphson method with polar coordinates, the size of the Jacobian is 100×100. If there are 20 PV buses in addition to PQ buses and a slack bus, the total number of buses in the system is _____.

Question Number : 26 **Correct : 2 Wrong : -0.66**

Let $g(x) = \begin{cases} -x, & x \le 1 \\ x+1, & x \ge 1 \end{cases}$ and $f(x) = \begin{cases} 1-x, & x \le 0 \\ x^2, & x > 0 \end{cases}$.

Consider the composition of f and g, i.e., $(f \circ g)(x) = f(g(x))$. The number of discontinuities in $(f \circ g)(x)$ present in the interval $(-\infty, 0)$ is:

(A) 0 (B) 1 (C) 2 (D) 4

Question Number : 27 **Correct : 2 Wrong : -0.66**

The value of the contour integral in the complex-plane

$$\oint \frac{z^3 - 2z + 3}{z - 2} dz$$

along the contour $|z| = 3$, taken counter-clockwise is

(A) $-18\pi i$ (B) 0 (C) $14\pi i$ (D) $48\pi i$

Question Number : 28 **Correct : 2 Wrong : -0.66**

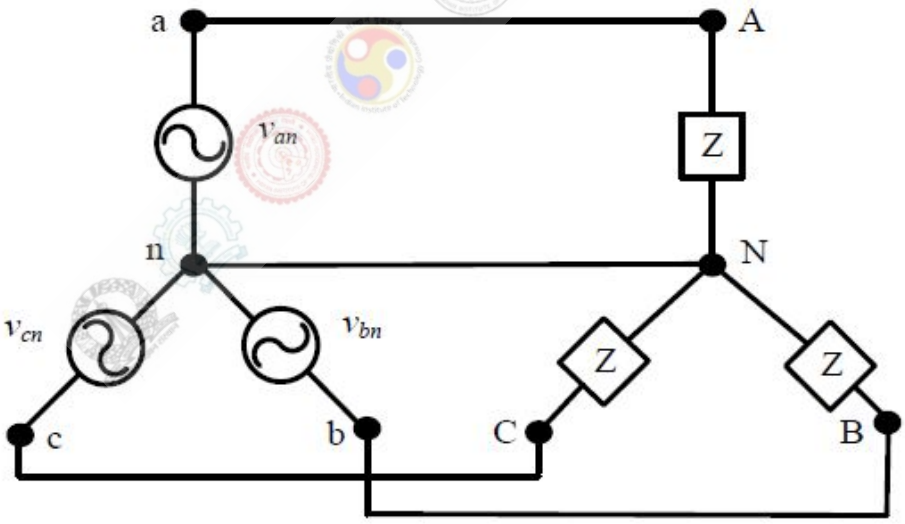
The eigenvalues of the matrix given below are

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -3 & -4 \end{bmatrix}$$

(A) (0,-1,-3) (B) (0, -2, -3) (C) (0, 2, 3) (D) (0, 1, 3)

Question Number : 29 **Correct : 2 Wrong : -0.66**

For the balanced Y-Y connected 3-phase circuit shown in the figure below, the line-line voltage is 208 V rms and the total power absorbed by the load is 432 W at a power factor of 0.6 leading.



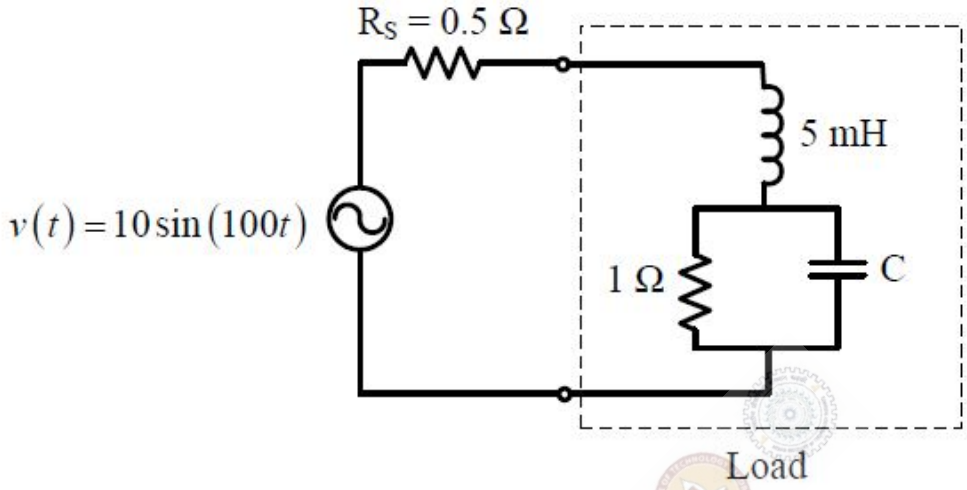
The approximate value of the impedance Z is

(A) $33 \angle -53.1^\circ\ \Omega$ (B) $60 \angle 53.1^\circ\ \Omega$

(C) $60 \angle -53.1^\circ\ \Omega$ (D) $180 \angle -53.1^\circ\ \Omega$

Question Number : 30 Correct : 2 Wrong : -0.66

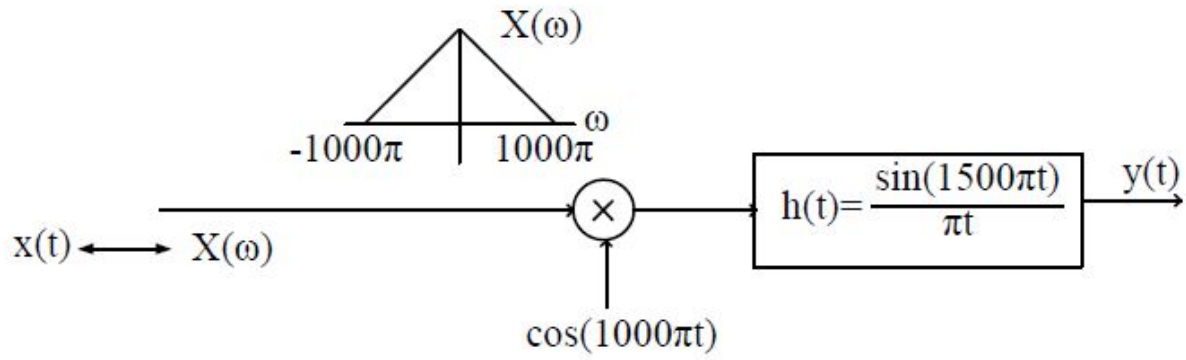
In the circuit shown below, the value of capacitor C required for maximum power to be transferred to the load is



(A) 1 nF (B) 1 μF (C) 1 mF (D) 10 mF

Question Number : 31 Correct : 2 Wrong : -0.66

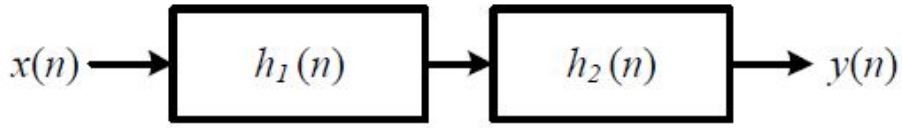
The output $y(t)$ of the following system is to be sampled, so as to reconstruct it from its samples uniquely. The required minimum sampling rate is



(A) 1000 samples/s (B) 1500 samples/s (C) 2000 samples/s (D) 3000 samples/s

Question Number : 32 **Correct : 2 Wrong : -0.66**

A cascade system having the impulse responses $h_1(n) = \{\underset{\uparrow}{1}, -1\}$ and $h_2(n) = \{\underset{\uparrow}{1}, 1\}$ is shown in the figure below, where symbol $\uparrow$ denotes the time origin.



The input sequence $x(n)$ for which the cascade system produces an output sequence $y(n) = \{\underset{\uparrow}{1}, 2, 1, -1, -2, -1\}$ is

(A) $x(n) = \{\underset{\uparrow}{1}, 2, 1, 1\}$

(B) $x(n) = \{\underset{\uparrow}{1}, 1, 2, 2\}$

(C) $x(n) = \{\underset{\uparrow}{1}, 1, 1, 1\}$

(D) $x(n) = \{\underset{\uparrow}{1}, 2, 2, 1\}$

Question Number : 33 **Correct : 2 Wrong : -0.66**

A 220 V, 10 kW, 900 rpm separately excited DC motor has an armature resistance $R_a = 0.02\,\Omega$. When the motor operates at rated speed and with rated terminal voltage, the electromagnetic torque developed by the motor is 70 Nm. Neglecting the rotational losses of the machine, the current drawn by the motor from the 220 V supply is

(A) 34.2 A
(B) 30 A
(C) 22 A
(D) 4.84 A

Question Number : 34 **Correct : 2 Wrong : -0.66**

The root locus of the feedback control system having the characteristic equation $s^2 + 6Ks + 2s + 5 = 0$ where $K > 0$, enters into the real axis at

(A) $s = -1$ (B) $s = -\sqrt{5}$ (C) $s = -5$ (D) $s = \sqrt{5}$

Question Number : 35 **Correct : 2 Wrong : -0.66**

The range of K for which all the roots of the equation $s^3 + 3s^2 + 2s + K = 0$ are in the left half of the complex s-plane is

(A) $0 < K < 6$
(B) $0 < K < 16$
(C) $6 < K < 36$
(D) $6 < K < 16$

Question Number : 36 **Correct : 2 Wrong : -0.66**

Which of the following systems has maximum peak overshoot due to a unit step input?

(A) $\frac{100}{s^2+10s+100}$

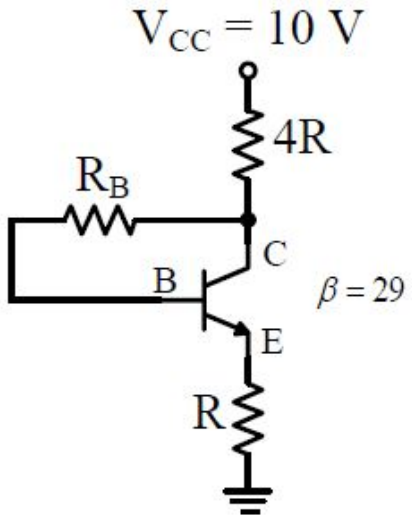
(B) $\frac{100}{s^2+15s+100}$

(C) $\frac{100}{s^2+5s+100}$

(D) $\frac{100}{s^2+20s+100}$

Question Number : 37 **Correct : 2 Wrong : -0.66**

For the circuit shown in the figure below, it is given that $V_{CE} = \frac{V_{CC}}{2}$. The transistor has $\beta = 29$ and $V_{BE} = 0.7$ V when the B-E junction is forward biased.

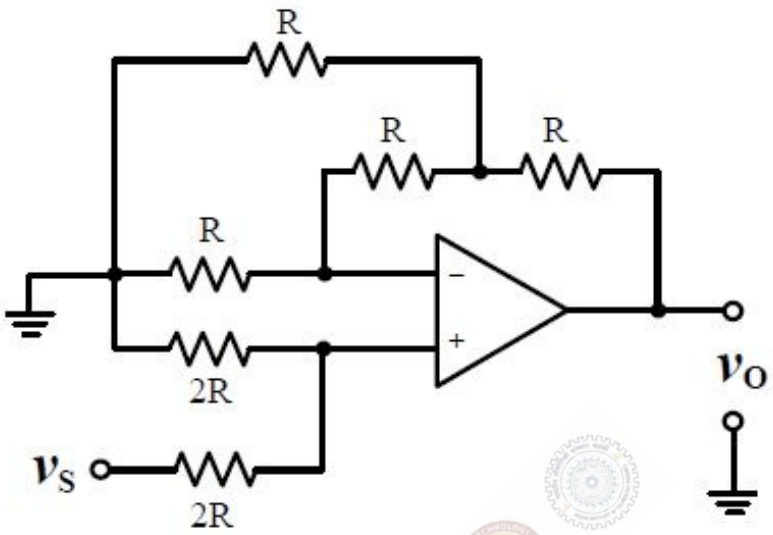


For this circuit, the value of $\frac{R_B}{R}$ is

(A) 43 (B) 92 (C) 121 (D) 129

Question Number : 38 **Correct : 2 Wrong : -0.66**

For the circuit shown below, assume that the OPAMP is ideal.



Which one of the following is TRUE?

(A) $v_o = v_s$

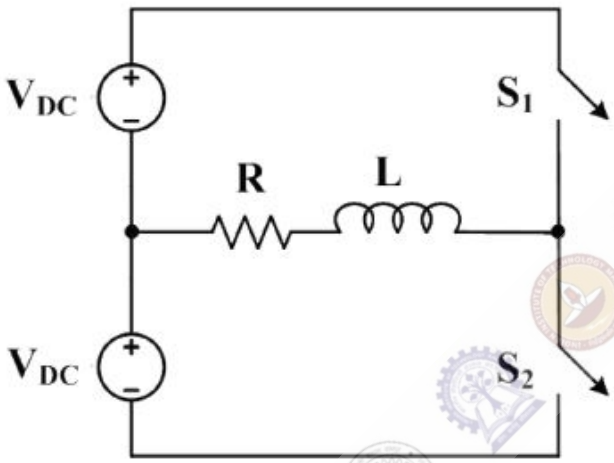
(B) $v_o = 1.5\, v_s$

(C) $v_o = 2.5\, v_s$

(D) $v_o = 5\, v_s$

Question Number : 39 Correct : 2 Wrong : -0.66

The figure below shows a half-bridge voltage source inverter supplying an RL-load with $R = 40\ \Omega$ and $L=\left(\frac{0.3}{\pi}\right)$ H. The desired fundamental frequency of the load voltage is 50 Hz. The switch control signals of the converter are generated using sinusoidal pulse width modulation with modulation index, $M = 0.6$. At 50 Hz, the RL-load draws an active power of 1.44 kW. The value of DC source voltage V_{DC} in volts is



(A) $300\sqrt{2}$
(B) 500
(C) $500\sqrt{2}$
(D) $1000\sqrt{2}$

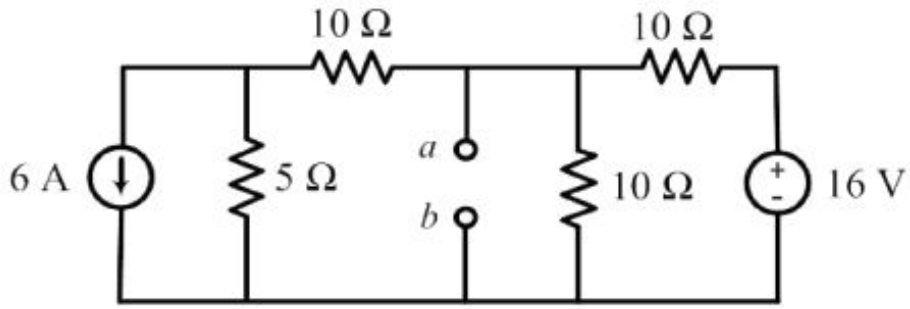
Question Number : 40 Correct : 2 Wrong : -0.66

A person decides to toss a fair coin repeatedly until he gets a head. He will make at most 3 tosses. Let the random variable Y denote the number of heads. The value of var$\{Y\}$, where var$\{\cdot\}$ denotes the variance, equals

(A) $\frac{7}{8}$ (B) $\frac{49}{64}$ (C) $\frac{7}{64}$ (D) $\frac{105}{64}$

Question Number : 41 **Correct : 2 Wrong : -0.66**

For the network given in figure below, the Thevenin's voltage V_{ab} is



(A) -1.5 V (B) - 0.5 V (C) 0.5 V (D) 1.5 V

Question Number : 42 **Correct : 2 Wrong : 0**

A 120 V DC shunt motor takes 2 A at no load. It takes 7 A on full load while running at 1200 rpm. The armature resistance is 0.8 Ω, and the shunt field resistance is 240 Ω. The no load speed, in rpm, is _____.

Question Number : 43 **Correct : 2 Wrong : 0**

A star-connected, 12.5kW, 208 V (line), 3-phase, 60 Hz squirrel cage induction motor has following equivalent circuit parameters per phase referred to the stator: R_1=0.3Ω, R_2=0.3Ω, X_1=0.41Ω, X_2=0.41Ω. Neglect shunt branch in the equivalent circuit. The starting current (in Ampere) for this motor when connected to an 80 V (line), 20 Hz, 3-phase AC source is _____.

Question Number : 44 **Correct : 2 Wrong : 0**

A 25 kVA, 400 V, Δ-connected, 3-phase, cylindrical rotor synchronous generator requires a field current of 5 A to maintain the rated armature current under short-circuit condition. For the same field current, the open-circuit voltage is 360 V. Neglecting the armature resistance and magnetic saturation, its voltage regulation (in % with respect to terminal voltage), when the generator delivers the rated load at 0.8 pf leading, at rated terminal voltage is _____.

Question Number : 45 Correct : 2 Wrong : 0

If the primary line voltage rating is 3.3 kV (Y side) of a 25 kVA, Y-Δ transformer (the per phase turns ratio is 5:1), then the line current rating of the secondary side (in Ampere) is _____.

Question Number : 46 Correct : 2 Wrong : 0

Consider the system described by the following state space representation

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix}=\begin{bmatrix}0 & 1\\ 0 & -2\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u(t)$$

$$y(t) = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}$$

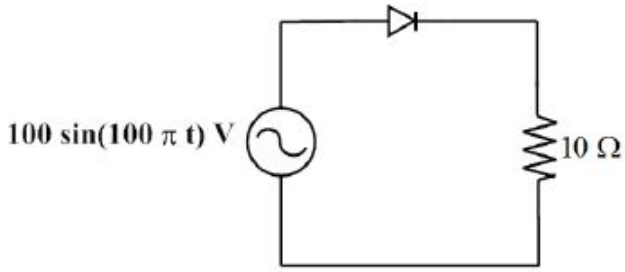
If $u(t)$ is a unit step input and $\begin{bmatrix}x_1(0)\\ x_2(0)\end{bmatrix}=\begin{bmatrix}1\\ 0\end{bmatrix}$, the value of output $y(t)$ at $t=1$ sec (rounded off to three decimal places) is _____

Question Number : 47 Correct : 2 Wrong : 0

A 10 ½ digit timer counter possesses a base clock of frequency 100 MHz. When measuring a particular input, the reading obtained is the same in: (i) Frequency mode of operation with a gating time of one second and (ii) Period mode of operation (in the x 10 ns scale). The frequency of the unknown input (reading obtained) in Hz is _____.

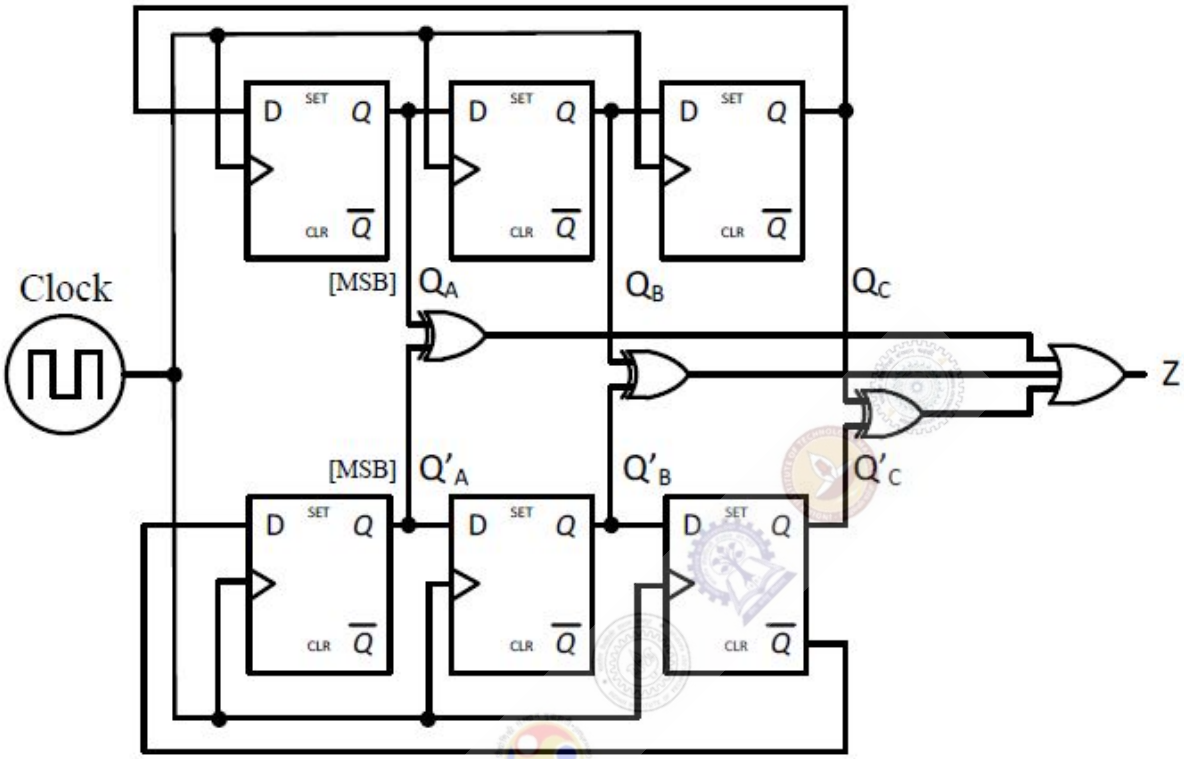
Question Number : 48 Correct : 2 Wrong : 0

In the circuit shown in the figure, the diode used is ideal. The input power factor is _____. (Give the answer up to two decimal places.)



Question Number : 49 **Correct : 2 Wrong : 0**

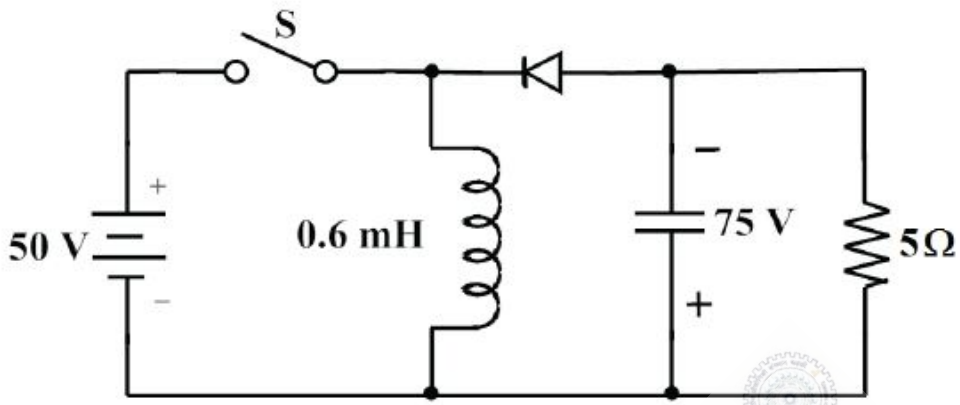
For the synchronous sequential circuit shown below, the output Z is zero for the initial conditions $Q_A Q_B Q_C = Q'_A Q'_B Q'_C = 100$.



The minimum number of clock cycles after which the output Z would again become zero is _____

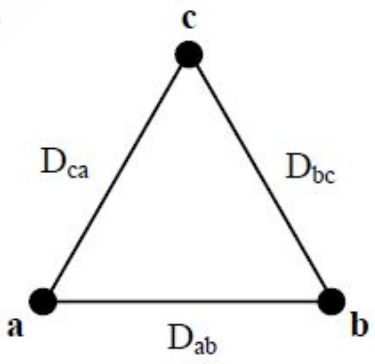
Question Number : 50 Correct : 2 Wrong : 0

In the circuit shown all elements are ideal and the switch S is operated at 10 kHz and 60% duty ratio. The capacitor is large enough so that the ripple across it is negligible and at steady state acquires a voltage as shown. The peak current in amperes drawn from the 50 V DC source is _____. (Give the answer up to one decimal place.)



Question Number : 51 Correct : 2 Wrong : 0

Consider an overhead transmission line with 3-phase, 50 Hz balanced system with conductors located at the vertices of an equilateral triangle of length $D_{ab} = D_{bc} = D_{ca} = 1m$ as shown in figure below. The resistances of the conductors are neglected. The geometric mean radius (GMR) of each conductor is 0.01 m. Neglecting the effect of ground, the magnitude of positive sequence reactance in Ω/km (rounded off to three decimal places) is _____



Question Number : 52 Correct : 2 Wrong : 0

A 3-phase, 50 Hz generator supplies power of 3MW at 17.32 kV to a balanced 3-phase inductive load through an overhead line. The per phase line resistance and reactance are 0.25Ω and 3.925Ω respectively. If the voltage at the generator terminal is 17.87 kV, the power factor of the load is _____.

Question Number : 53 **Correct : 2 Wrong : 0**

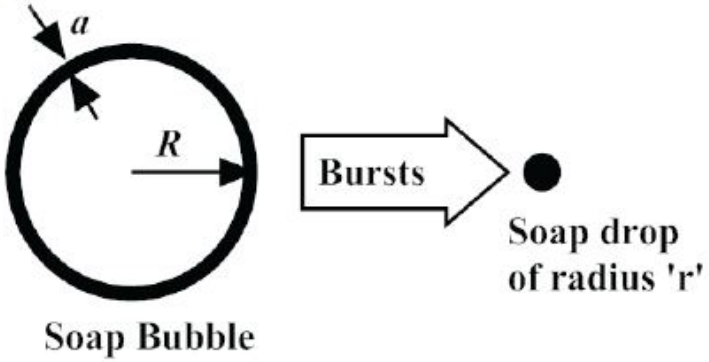
Two generating units rated 300 MW and 400 MW have governor speed regulation of 6% and 4% respectively from no load to full load. Both the generating units are operating in parallel to share a load of 600 MW. Assuming free governor action, the load shared by the larger unit is _____MW.

Question Number : 54 **Correct : 2 Wrong : 0**

A 3-phase, 2-pole, 50 Hz, synchronous generator has a rating of 250 MVA, 0.8 pf lagging. The kinetic energy of the machine at synchronous speed is 1000 MJ. The machine is running steadily at synchronous speed and delivering 60 MW power at a power angle of 10 electrical degrees. If the load is suddenly removed, assuming the acceleration is constant for 10 cycles, the value of the power angle after 5 cycles is _____electrical degrees.

Question Number : 55 **Correct : 2 Wrong : 0**

A thin soap bubble of radius $R = 1$ cm, and thickness $a = 3.3\ \mu$m ($a \ll R$), is at a potential of 1 V with respect to a reference point at infinity. The bubble bursts and becomes a single spherical drop of soap (assuming all the soap is contained in the drop) of radius r. The volume of the soap in the thin bubble is $4\pi R^2 a$ and that of the drop is $\frac{4}{3}\pi r^3$. The potential in volts, of the resulting single spherical drop with respect to the same reference point at infinity is _____. (Give the answer up to two decimal places.)



Question Number : 56 **Correct : 1 Wrong : -0.33**

Choose the option with words that are not synonyms.

(A) aversion, dislike
(B) luminous, radiant
(C) plunder, loot
(D) yielding, resistant

Question Number : 57 **Correct : 1 Wrong : -0.33**

Saturn is _____ to be seen on a clear night with the naked eye.

(A) enough bright (B) bright enough (C) as enough bright (D) bright as enough

Question Number : 58 **Correct : 1 Wrong : -0.33**

There are five buildings called V, W, X, Y and Z in a row (not necessarily in that order). V is to the West of W. Z is to the East of X and the West of V. W is to the West of Y. Which is the building in the middle?

(A) V (B) W (C) X (D) Y

Question Number : 59 **Correct : 1 Wrong : -0.33**

A test has twenty questions worth 100 marks in total. There are two types of questions. Multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?

(A) 12 (B) 15 (C) 18 (D) 19

Question Number : 60 **Correct : 1 Wrong : -0.33**

There are 3 red socks, 4 green socks and 3 blue socks. You choose 2 socks. The probability that they are of the same colour is

(A) 1/5 (B) 7/30 (C) 1/4 (D) 4/15

Question Number : 61 **Correct : 2 Wrong : - 0.66**

"We lived in a culture that denied any merit to literary works, considering them important only when they were handmaidens to something seemingly more urgent – namely ideology. This was a country where all gestures, even the most private, were interpreted in political terms."

The author's belief that ideology is not as important as literature is revealed by the word:

(A) 'culture' (B) 'seemingly' (C) 'urgent' (D) 'political'

Question Number : 62 **Correct : 2 Wrong : -0.66**

There are three boxes. One contains apples, another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labelled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes?

(A) The box labelled 'Apples'
(B) The box labelled 'Apples and Oranges'
(C) The box labelled 'Oranges'
(D) Cannot be determined

Question Number : 63 **Correct : 2 Wrong : -0.66**

X is a 30 digit number starting with the digit 4 followed by the digit 7. Then the number X^3 will have

(A) 90 digits (B) 91 digits (C) 92 digits (D) 93 digits

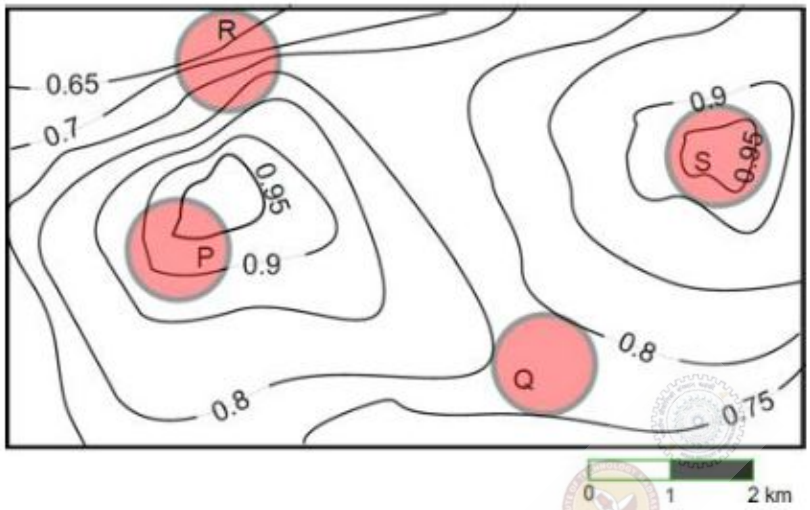
Question Number : 64 **Correct : 2 Wrong : -0.66**

The number of roots of $e^x + 0.5x^2 - 2 = 0$ in the range $[-5, 5]$ is

(A) 0 (B) 1 (C) 2 (D) 3

Question Number : 65 **Correct : 2 Wrong : -0.66**

An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air pressure contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.



If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region, which of the following regions is most likely to have a thunderstorm?

(A) P (B) Q (C) R (D) S

Q. No.	Type	Section	Key	Marks
1	MCQ	EE-2	A	1
2	MCQ	EE-2	B	1
3	MCQ	EE-2	C	1
4	MCQ	EE-2	B	1
5	MCQ	EE-2	B	1
6	MCQ	EE-2	D	1
7	MCQ	EE-2	A	1
8	MCQ	EE-2	A	1
9	MCQ	EE-2	D	1
10	MCQ	EE-2	C	1
11	MCQ	EE-2	C	1
12	MCQ	EE-2	A	1
13	MCQ	EE-2	B	1
14	MCQ	EE-2	C	1
15	MCQ	EE-2	D	1
16	NAT	EE-2	0 to 0	1
17	NAT	EE-2	0.9 to 0.9	1
18	NAT	EE-2	40 to 40	1
19	NAT	EE-2	7 to 7	1
20	NAT	EE-2	5.7 to 5.8	1
21	NAT	EE-2	3 to 3	1
22	NAT	EE-2	99 to 101	1
23	NAT	EE-2	6 to 6	1
24	NAT	EE-2	404 to 409	1
25	NAT	EE-2	61 to 61	1
26	MCQ	EE-2	A	2
27	MCQ	EE-2	C	2
28	MCQ	EE-2	A	2
29	MCQ	EE-2	C	2
30	MCQ	EE-2	D	2
31	MCQ	EE-2	B	2
32	MCQ	EE-2	D	2
33	MCQ	EE-2	B	2
34	MCQ	EE-2	B	2
35	MCQ	EE-2	A	2
36	MCQ	EE-2	C	2

37	MCQ	EE-2	D	2
38	MCQ	EE-2	C	2
39	MCQ	EE-2	C	2
40	MCQ	EE-2	C	2
41	MCQ	EE-2	A	2
42	NAT	EE-2	1235 to 1250	2
43	NAT	EE-2	69 to 71	2
44	NAT	EE-2	-15 to -14	2
45	NAT	EE-2	37 to 39	2
46	NAT	EE-2	1.280 to 1.287	2
47	NAT	EE-2	10000 to 10000	2
48	NAT	EE-2	0.70 to 0.71	2
49	NAT	EE-2	6 to 6	2
50	NAT	EE-2	39 to 41	2
51	NAT	EE-2	0.271 to 0.301	2
52	NAT	EE-2	0.75 to 0.85	2
53	NAT	EE-2	395 to 405	2
54	NAT	EE-2	12.5 to 12.9	2
55	NAT	EE-2	9.50 to 10.50	2
56	MCQ	GA	D	1
57	MCQ	GA	B	1
58	MCQ	GA	A	1
59	MCQ	GA	B	1
60	MCQ	GA	D	1
61	MCQ	GA	B	2
62	MCQ	GA	B	2
63	MCQ	GA	A	2
64	MCQ	GA	C	2
65	MCQ	GA	C	2