ASSIGNMENT 15 GATE 2

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1. Consider function $f(x) = \left(x^2 - 4\right)^2$ where x is a real number. Then the function has
   (a) only one minimum
   (b) only two minima
   (c) three minima
   (d) three maxima

2. Equation $e^x - 1 = 0$ is required to be solved using Newton's method with an initial guess $x_0 = -1$. Then, after one step of Newton's method, estimate x_1 of the solution will be given by
   (a) 0.71828
   (b) 0.36784
   (c) 0.20587
   (d) 0.00000

3. A is an $m \times n$ full rank matrix with $m > n$ and I is an identity matrix. Let matrix $A^+ = \left(A^T A\right)^{-1} A^T$. Then, which one of the following statements is FALSE?
   (a) $AA^+A = A$
   (b) $(AA^+)^2 = AA^+$
   (c) $A^+A = I$
   (d) $AA^+A = A^+$

4. A differential equation $\frac{dx}{dt} = e^{-2t}u(t)$ has to be solved using the trapezoidal rule of integration with a step size $h = 0.01$ s. Function $u(t)$ indicates a unit step function. If $x(0-) = 0$, then the value of x at $t = 0.01$ s will be given by:
   (a) 0.00099
   (b) 0.00495

(c) 0.0099
(d) 0.0198

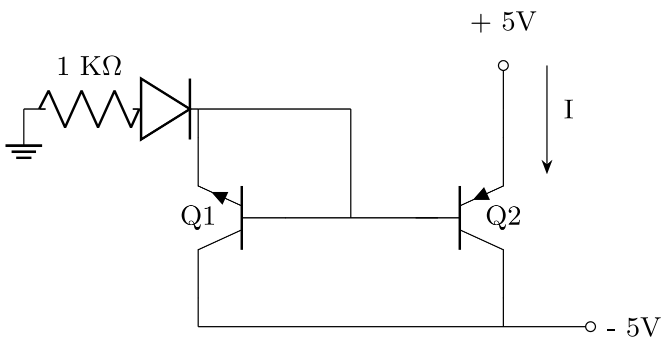
5. Let P be a 2×2 real orthogonal matrix and $\vec{x}$ is a real vector $[x_1, x_2]^T$ with length $|\vec{x}| = \left(x_1^2 + x_2^2\right)^{1/2}$. Then, which one of the following statements is correct?

(a) $|P\vec{x}| \leq |\vec{x}|$ where at least one vector satisfies $|P\vec{x}| < |\vec{x}|$
(b) $|P\vec{x}| = |\vec{x}|$ for all vectors $\vec{x}$
(c) $|P\vec{x}| \geq |\vec{x}|$ where at least one vector satisfies $|P\vec{x}| > |\vec{x}|$
(d) No relationship can be established between $|\vec{x}|$ and $|P\vec{x}|$

6. Let $x(t) = rect\left(t - \frac{1}{2}\right)$ where $rect(x) = 1$ for $-\frac{1}{2} \leq x \leq \frac{1}{2}$ and zero otherwise. Then if $\text{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$, the Fourier Transform of $x(t) + x(-t)$ will be given by

(a) $\text{sinc}\left(\frac{\omega}{2\pi}\right)$
(b) $2\ \text{sinc}\left(\frac{\omega}{2\pi}\right)$
(c) $2\ \text{sinc}\left(\frac{\omega}{2\pi}\right) \cos\left(\frac{\omega}{2}\right)$
(d) $\text{sinc}\left(\frac{\omega}{2\pi}\right) \sin\left(\frac{\omega}{2}\right)$

7. Two perfectly matched silicon transistors are connected as shown in the figure. Assuming the β of the transistors to be very high and the forward voltage drop in diodes to be 0.7V, the value of current I is

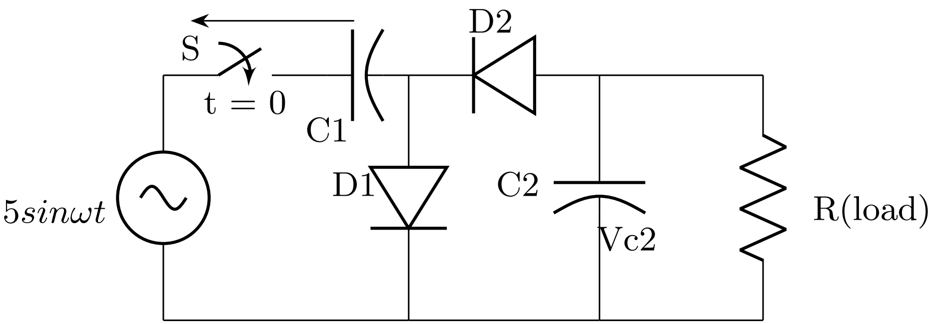


(a) $0mA$
(b) $3.6mA$
(c) $4.3mA$
(d) $5.7mA$

8. A $230V$, $50Hz$, 4-pole, single-phase induction motor is rotating in the clockwise $(forward)$ direction at a speed of $1425rpm$. If the rotor resistance at standstill is 7.8 Ω, then the effective rotor resistance in the backward branch of the equivalent circuit will be

   (a) 2Ω
   (b) 4Ω
   (c) 7.8Ω
   (d) 156Ω

9. In the voltage doubler circuit shown in the figure, the switch S is closed at $(t = 0)$ Assuming diodes D_1 and D_2 to be ideal, load resistance to be infinite and initial capacitor voltages to be zero, the steady state voltage across capacitors C_1 and C_2 will be

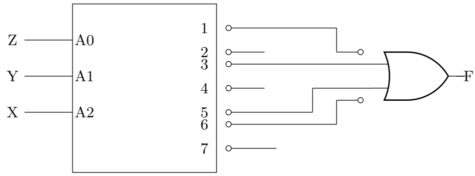


   (a) 2Ω
   (b) 4Ω
   (c) 7.8Ω
   (d) 156Ω

10. A $400V$, $50Hz$, $30hp$, three-phase induction motor is drawing $50A$ current at 0.8 power factor lagging. The stator and rotor copper losses are $1.5kW$ and $900W$ respectively. The friction and windage losses are $1050W$ and the core losses are $1200W$. The air-gap power of the motor will be

    (a) $23.06kW$
    (b) $24.11kW$
    (c) $25.01kW$
    (d) $26.21kW$

11. A 3 line to 8 line decoder, with active low outputs, is used to implement a 3-variable Boolean function as shown in the figure. The simplified form of Boolean function $F(A, B, C)$ implemented in 'Product of Sum' form will be



(a) $(X+Z).\left(\overline{X}+\overline{Y}+\overline{Z}\right).(Y+Z)$

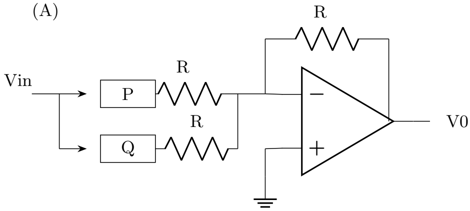
(b) $\left(\overline{X}+\overline{Z}\right).(X+Y+Z).\left(\overline{Y}+\overline{Z}\right)$

(c) $\left(\overline{X}+\overline{Y}+Z\right).\left(\overline{X}+Y+Z\right).\left(X+\overline{Y}+Z\right).\left(X+Y+\overline{Z}\right)$

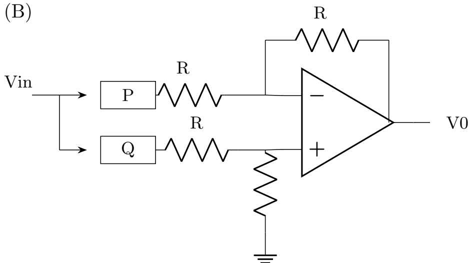
(d) $\left(\overline{X}+\overline{Y}+\overline{Z}\right).\left(\overline{X}+Y+\overline{Z}\right).(X+Y+Z).\left(X+\overline{Y}+\overline{Z}\right)$

12. The block diagrams of two types of half-wave rectifiers are shown in the figure. The transfer characteristics of the rectifiers are also shown within the block. It is desired to make full wave rectifier using above two half-wave rectifiers. The resultant circuit will be

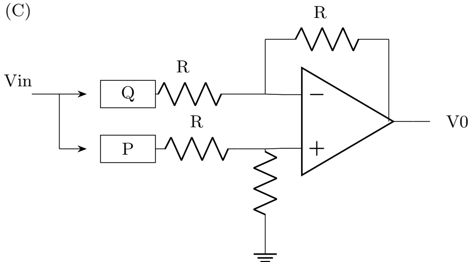
(A)



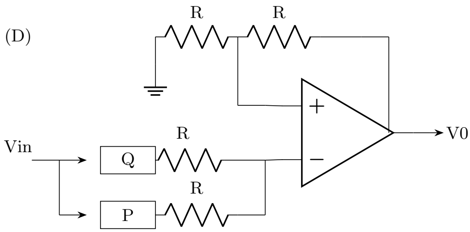
(B)



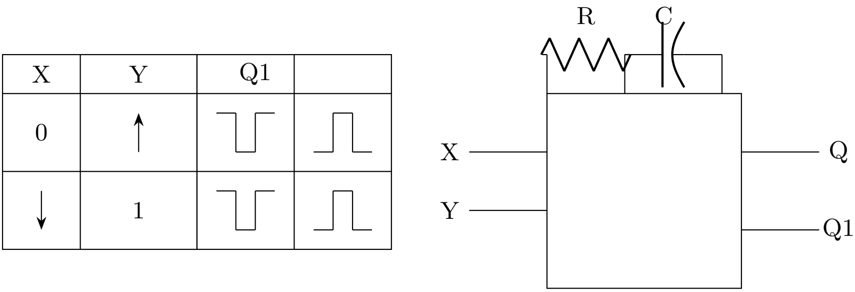
(C)

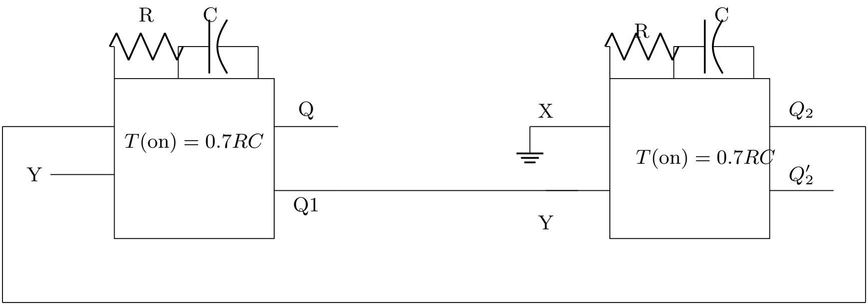


(D)



13. The truth table of a monoshot shown in the figure is given in the table given below: Two monoshots, one positive edge triggered and other negative edge triggered, are connected as shown in the figure. The pulse widths of the two monoshots outputs, Q_1 and Q_2, are T_{ON1} and T_{ON2}, respectively. The frequency and the duty cycle of the signal at Q_1 will respectively be





(a) $f = \frac{1}{T_{ON_1}+T_{ON_2}}$, $D = \frac{T_{ON_1}}{T_{ON_1}+T_{ON_2}}$

(b) $f = \frac{1}{T_{ON_1}+T_{ON_2}}$, $D = \frac{T_{ON_2}}{T_{ON_1}+T_{ON_2}}$

(c) $f = \frac{1}{T_{ON_1}}$, $D = \frac{T_{ON_1}}{T_{ON_1}+T_{ON_2}}$

(d) $f = \frac{1}{T_{ON_2}}$, $D = \frac{T_{ON_1}}{T_{ON_1}+T_{ON_2}}$

14. The contents ($inHexadecimal$) of some of the memory locations in an 8085A based system are given below:

Address	Contents
...	...
$26FE$	00
$26FF$	01
2700	02
2701	03
2702	04
...	...

The contents of stack pointer (SP), program counter (PC) and $(H.L)$ are $2700H$, $2100H$ and $0000H$ respectively. When the following sequence of instructions are executed,

assembly $2100H$: $DADSP$; $2101H$: $PCHL$

the contents of (SP) and (PC) at the end of execution will be

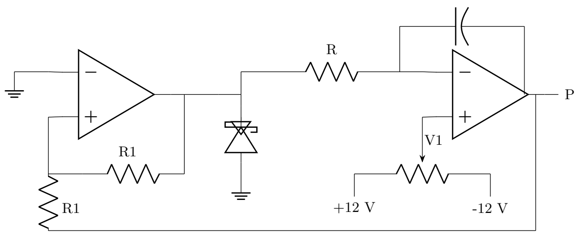
(a) $(PC) = 2102H$, $(SP) = 2700H$

(b) $(PC) = 2700H$, $(SP) = 2700H$

(c) $(PC) = 2800H$, $(SP) = 26FEH$

(d) $(PC) = 2A02H$, $(SP) = 2702H$

15. A waveform generator circuit using OPAMPs is shown in the figure. It produces a triangular wave at point P with a peak to peak voltage of $5V$ for $v_i = 0$ V. If the voltage v, is made $+2.5V$, the voltage waveform at point P will become



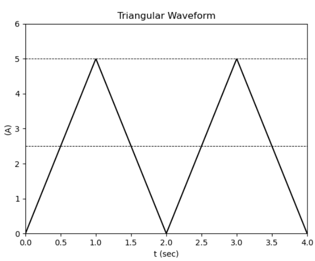


Figure 1: Option A

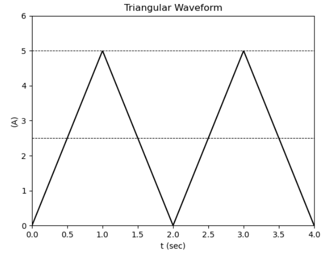


Figure 2: Option B

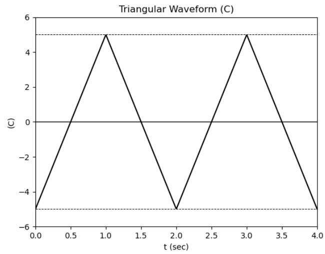


Figure 3: Option C

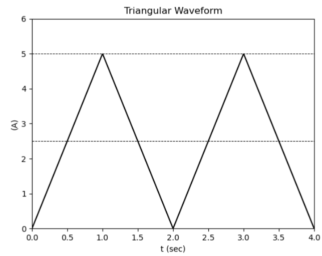


Figure 4: Option D

16. Voltage phasors at the two terminals of a transmission line of length $70km$ have a magnitude of 1.0 per unit but are 180 degrees out of phase. Assuming that the maximum load current in the line is $1/5th$ of minimum 3-phase fault current, which one of the following transmission line protection schemes will NOT pick up for this condition?

   (a) Distance protection using mho relays with zone-1 set to 80 of the line impedance

   (b) Directional overcurrent protection set to pick up at 1.25 times the maximum load current

(c) Pilot relaying system with directional comparison scheme

(d) Pilot relaying system with segregated phase comparison scheme

17. A lossless transmission line having Surge Impedance Loading (SIL) of $2280MW$ is provided with a uniformly distributed series capacitive compensation of 30 . Then, SIL of the compensated transmission line will be

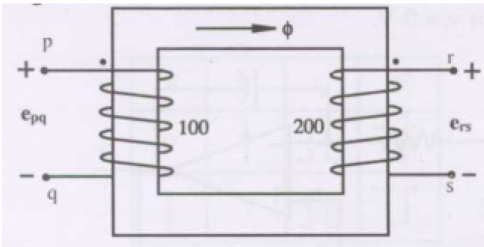
(a) $1835MW$

(b) $2280MW$

(c) $2725MW$

(d) $3257MW$

18. The core of a two transformer is subjected to a magnetic flux variation as indicated in the figure. the induced EMF in the secondary winding as a function of time will be in the form.



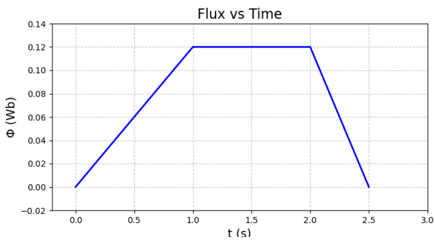


Figure 5: OPTIONS ARE GIVEN BELOW

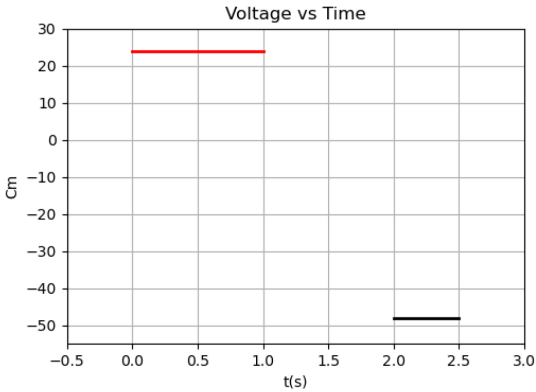


Figure 6: A

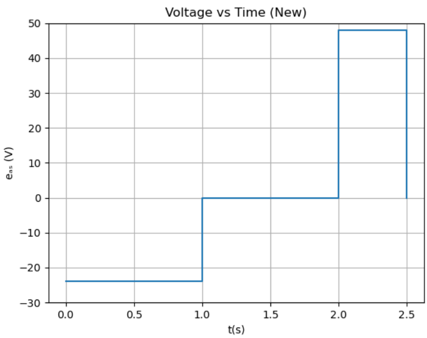


Figure 7: B

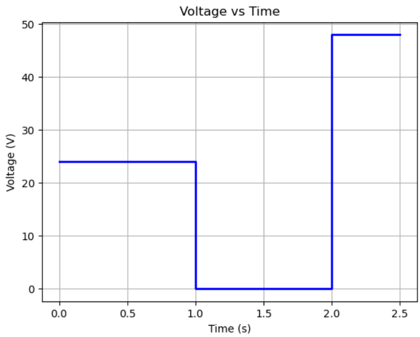


Figure 8: C

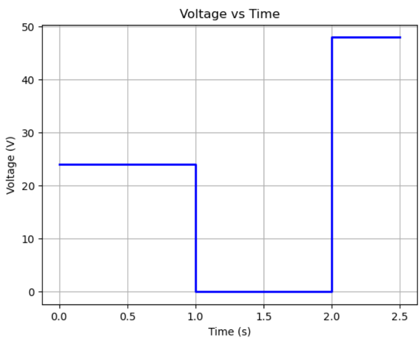


Figure 9: D