



राष्ट्रीय प्रौद्योगिकी संस्थान दिल्ली

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संस्थान)

(An autonomous Institute under the aegis of Ministry of Education (Shiksha Mantralaya), Govt. of India)

Plot No. FA7, Zone P1, GT Karnal Road, Delhi-110036, INDIA

दूरभाष/Tele: +9111-33861000, 1001, 1005 फ़ैक्स/ Fax: +9111-27787503,

वेबसाइट/Website: www.nitdelhi.ac.in

NOTICE

Advt. No. 08/ 2024: Answer Key and Representations Invited for the Domain

Knowledge Tests held on 06.02.2025

Position	Electronics and Communication Engineering (ECE): Assistant Professor Grade II (Pay Level 10) (On Contract Basis)
Date	06.02.2025 (Thursday)
Examination Time	4:00 Pm - 5:00 PM

Following is the attached answer key. If any appeared candidate for the domain knowledge test has any representations against the questions, may submit by filling up the following Google Form on or before 09.02.2025 11:59 PM. After that no representations will be considered.

Google Form Link:

https://docs.google.com/forms/d/e/1FAIpQLSdSL0LirIHEwHuM5H3WDc2ls6hztZlKe_SeUZG1XVxWfACQ7Q/viewform?usp=preview



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QUESTION PAPER FOR THE POST OF ASSISTANT PROFESSOR ECE (PAY LEVEL 10)

Maximum Marks: 50

Time: 90 Minutes

Name of Candidate: _____ Roll No: _____

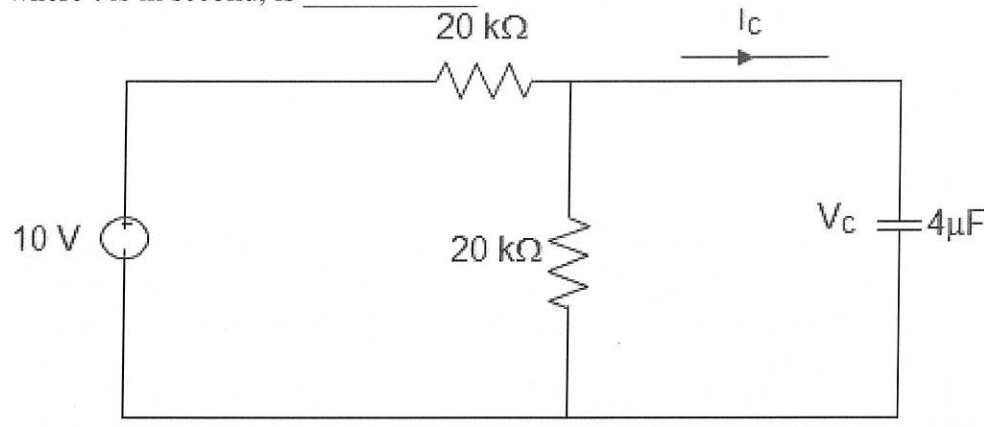
INSTRUCTIONS TO CANDIDATES

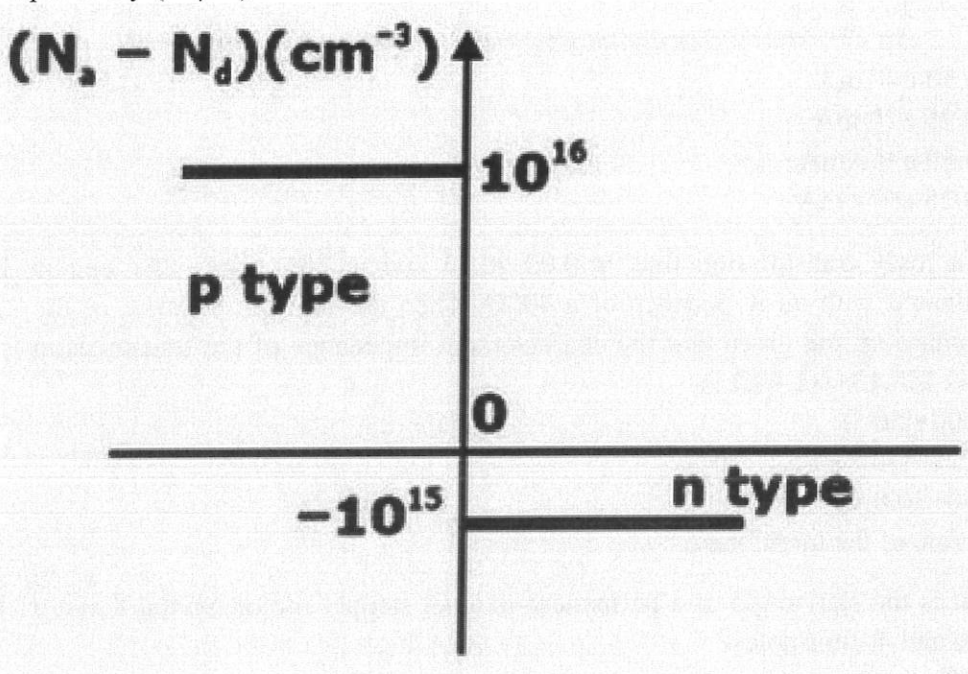
1. This question paper has 50 questions. Each question carries one mark. There are four choices for answer (A, B, C, D) to each question. Choose the correct answer (one only) for each question and write the answer in the space provided against each question.
2. Candidate must write Name, Roll No. and sign on each page of this booklet.
3. The candidate should check that the booklet does not have any unprinted or torn or missing pages or questions etc. If so, get it replaced with another question paper, before question paper starts.
4. One (1) mark will be awarded for each correct answer. There will be negative marking and (- ¼) mark will be awarded for each incorrect answer.
5. The unanswered questions will not attract negative marking
6. Return the Question Paper cum Answer Sheet to the invigilator after the examination is over.
7. **Mobile, Electronic Watch** and other **Electronic Gadgets** are prohibited in the examination.
8. There should not be any cutting or overwriting in the Answer.
9. Use of Unfair Means in Examination will lead to cancellation of candidature.

अभ्यर्थियों के लिए अनुदेश

1. इस प्रश्न पत्र में 50 प्रश्न हैं। प्रत्येक प्रश्न एक अंक का है। प्रत्येक प्रश्न के उत्तर के लिए चार विकल्प (A, B, C, D) हैं। प्रत्येक प्रश्न के लिए सही उत्तर (केवल एक) चुनें और प्रत्येक प्रश्न के सामने दिए गए स्थान पर उत्तर लिखें।
2. अभ्यर्थी को इस पुस्तिका के प्रत्येक पृष्ठ पर अपना नाम, रोल नंबर लिखना होगा तथा हस्ताक्षर करना होगा।
3. अभ्यर्थी को यह जांचना चाहिए कि पुस्तिका में कोई भी बिना छपा हुआ या फटा हुआ या गायब पृष्ठ या प्रश्न आदि नहीं है। यदि ऐसा है, तो प्रश्न पत्र शुरू होने से पहले इसे दूसरे प्रश्न पत्र से बदल लें।
4. प्रत्येक सही उत्तर के लिए एक (1) अंक दिया जाएगा। नकारात्मक अंकन होगा और प्रत्येक गलत उत्तर के लिए (- ¼) अंक दिया जाएगा।
5. अनुत्तरित प्रश्न नकारात्मक अंकन को आकर्षित नहीं करेंगे
6. परीक्षा समाप्त होने के बाद प्रश्न पत्र सह उत्तर पुस्तिका पर्यवेक्षक को लौटा दें।
7. मोबाइल, इलेक्ट्रॉनिक घड़ी और अन्य इलेक्ट्रॉनिक गैजेट्स परीक्षा में वर्जित हैं।
8. उत्तर में कोई कटिंग या ओवरराइटिंग नहीं होनी चाहिए।
9. परीक्षा में अनुचित साधनों का प्रयोग करने पर उम्मीदवारी रद्द कर दी जाएगी।

S.NO.	Question	Ans														
1	<p>The covering angle of spot beam antenna is 4.5 and the beam angle of global coverage antenna is 17.34. Both the antennas are attached with a geostationary satellite. The gain of global coverage antenna is 50 dB. Calculate gain of spot beam antenna.</p> <p>(a) 61.3 dB (b) 62.3 dB (c) 61.7 dB (d) 62.7 dB</p>	C														
2	<p>Consider the following set of instructions executed by 8085 microprocessor:</p> <table border="0"> <thead> <tr> <th>Addresses (HEX)</th> <th>Instructions</th> </tr> </thead> <tbody> <tr> <td>6010 H</td> <td>LXI 8479 H</td> </tr> <tr> <td>6013 H</td> <td>MOV A,L</td> </tr> <tr> <td>6014 H</td> <td>ADD H</td> </tr> <tr> <td>6015 H</td> <td>DAA</td> </tr> <tr> <td>6016 H</td> <td>MOV H, A</td> </tr> <tr> <td>6017 H</td> <td>PCHL</td> </tr> </tbody> </table> <p>(a) 6018 H (b) 6979 H (c) 6373 H (d) 6015 H</p>	Addresses (HEX)	Instructions	6010 H	LXI 8479 H	6013 H	MOV A,L	6014 H	ADD H	6015 H	DAA	6016 H	MOV H, A	6017 H	PCHL	B
Addresses (HEX)	Instructions															
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3	<p>Fiber Bragging Detector are used in following:</p> <p>(1) Wavelength filtering (2) EDFA (3) Photodetectors (4) Dispersion compensators</p> <p>(a) (1), (2) and (4) are correct (b) (1), (2) and (3) are correct (c) (1) and (3) are correct (d) None of these</p>	A														
4	<p>A wave is propagated in a parallel plane waveguide. If the frequency is 6 GHz and the plane separation is 3cm then the cut off wavelength for the dominant mode will be:</p> <p>(a) 3 cm (b) 6 cm (c) 12 cm (d) 9 cm</p>	B														

5	<p>In the circuit shown, V_C is zero at $t=0$ s. For $t>0$, the capacitor current $I_C(t)$, where t is in second, is _____</p>  <p>(a) $0.50 e^{-25t}$ mA (b) $0.25 e^{-25t}$ mA (c) $0.50 e^{-12.5t}$ mA (d) $0.25 e^{-6.25t}$ mA</p>	A
6	<p>For a lossy transmission line, $\gamma=0.02+j0.15$ and is 20m long. The line is terminated with an impedance of a 400Ω. Then the input impedance of the transmission line given that the characteristic impedance of the transmission line is $156.13+j11.38\Omega$ is:</p> <p>(a) $100+j50 \Omega$ (b) $228+j36.8 \Omega$ (c) $50+36.8j \Omega$ (d) none of the mentioned</p>	B
7	<p>What is the step angle of a permanent-magnet stepper motor having 8 stator poles and 4 rotor poles?</p> <p>(a) 60° (b) 45° (c) 30° (d) 15°</p>	B
8	<p>The parameter in the base region of a non bipolar transistor are $D_n= 20 \text{ cm}^2/\text{s}$, $N_{B0} = 10^4 \text{ cm}^{-3}$, $X_B = 1\mu\text{m}$, $A_{BE} = 10^{-4} \text{ cm}^2$. What will be the collector current for $V_{BE} = 0.5 \text{ V}$?</p> <p>(a) $7.75 \mu\text{A}$ (b) $-7.74 \mu\text{A}$ (c) $7.74 \mu\text{A}$ (d) $-7.75 \mu\text{A}$</p>	A
9	<p>A synchronous generator is feeding a zero power factor (lagging) load at rated current. The armature reaction is:</p> <p>(A) Magnetising (B) Cross-magnetising (C) Demagnetising (D) Ineffective</p>	C

10	<p>A magnetic circuit of reluctance 3000 A-turns/Wb is wound by a wire of 400 turns. Determine the average emf induced (in V) in the coil, if a current of 2 A is flowing in the coil is reversed in 15s.</p> <p>(A) 16.24 (B) 17.98 (C) 14.24 (D) 15.37</p>	C
11	<p>Consider the impurity doping profile in a silicon pn junction as shown in figure below. Assume that zero voltage is applied to pn junction. What will be the distances that space charge regions extend into n and p regions respectively (in μm)?</p>  <p>(A) 0.864, 0.864 (B) 1.157, 1.157 (C) 0.864, 1.157 (D) 0.864, 1.157</p>	A
12	<p>Which of the following instructions do not use stack?</p> <p>(A) CALL (B) XTHL (C) JMP (D) RET</p>	C
13	<p>Consider two infinite duration input sequences $\{x_1[n], x_2[n]\}$. When will the region of convergence of z-transform of their superposition be entire z-plane except possibly at $z=0$ or $z=\infty$.</p> <p>(A) when they are left sided sequences (B) When they are right sided sequences (C) When the linear combination is of finite duration (D) None of the above</p>	C

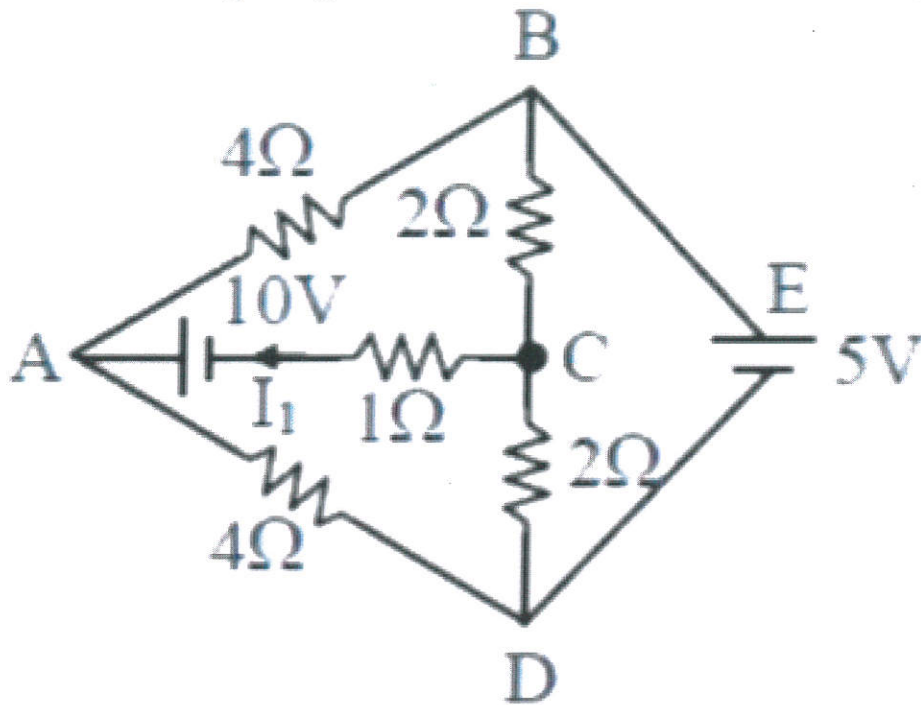
14	<p>To configure port A and B as output ports, port C not being used in 8155 programmable interface, the control word should have the value.</p> <p>(A) 03 H (B) 02 H (C) 60 H (D) 01H</p>	A
15	<p>Weak components of a signal with non flat PSD can be protected against channel noise and frequency dependent channel response by a pair of spectral operations. These components can be amplified before transmission and attenuated after reception. Leading to both flat end- to-end channel response and higher SNR. What are the names of these operations?</p> <p>(A) compression- expansion (B) Amplify attenuate (C) Emphasize-deemphasize (D) Channel equalisation</p>	C
16	<p>During transmission over a certain binary communication channel, bit error occurs independently with probability p. The probability of almost one bit in error in a block of n bits is given by:</p> <p>(A) p^n (B) $1 - p^n$ (C) $np(1-p)^{n-1} - (1-p)^n$ (D) $np(1-p)^{n-1} + (1-p)^n$</p>	D
17	<p>The input X to Binary Symmetric Channel is '1', as shown in figure with probability 0.8. the cross-over probability is $1/7$. If the received bit $Y = 0$, the conditional probability that '1' was transmitted is _____</p> <div style="text-align: center;"> </div> <p>(A) 0.5 (B) 0.6 (C) 0.3 (D) 0.4</p>	D

18	<p>What is the image rejection ratio when a super heterodyne receiver with quality factor of 50 is tuned with $f_s = 800$ kHz and local oscillator frequency is 1250 kHz.</p> <p>(A) 81.7 (B) 82.7 (C) 81.1 (D) 82.1</p>	B
19	<p>Consider the following loop:</p> <pre>MOV CX, 8000h L1: DEC CX JNZ L1</pre> <p>The processor is running at 14.7456/3 MHz and DEC CX requires 2 clock cycles and JNZ require 16 clock cycles. The total time taken is nearly:</p> <p>(a) 0.12 s (b) 0.02 s (c) 3.66 s (d) 4.02 s</p>	A
20	<p>A bulb and a capacitor are connected in series across an ac supply. A dielectric is then plates between plates of capacitor. The glow of the bulb:</p> <p>(A) remains constant (B) Increases (C) Decreases (D) Remains constant</p>	B

21

The current flowing through 1 ohm resistor is $n/10$. Then the value of n is ____

C



- (A) 15
 (B) 20
 (C) 25
 (D) 30

22

Compare the energies of following sets of quantum numbers for multi electron system.

D

- (A) $n=4, l=1$
 (B) $n=4, l=2$
 (C) $n=3, l=1$
 (D) $n=3, l=2$
 (E) $n=4, l=0$

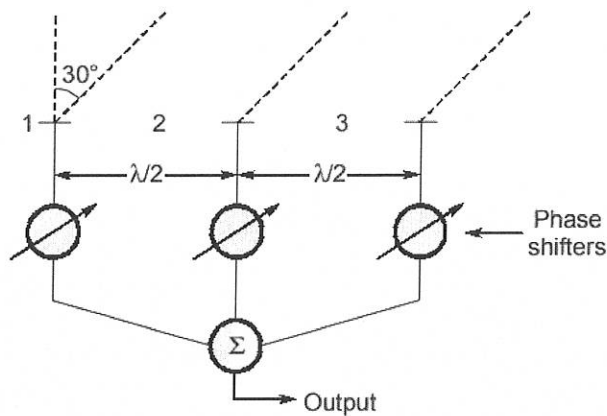
Choose the correct answer from the options given below:

- (A) $B > A > C > E > D$
 (B) $E > C < D < A < B$
 (C) $C > E > D > A > B$
 (D) $C < E < D < A < B$

23	<p>Consider the state space system expressed by signal flow diagram shown in the figure:</p>	C
<p>(A) always observable (B) Always stable (C) Always controllable (D) Always unstable</p>		
24	<p>Determine the potential at point A(3,2,1), if the potential at point B(1,4,3) is 12V in the given electric field, $E = 3x^2 a_x + ya_y + 2za_z$</p>	A
<p>(a) 0 V (b) 12 V (c) -12 V (d) 24 V</p>		
25	<p>In free space, $H = 0.1 \cos(\omega t - \beta x) a_z$ A/m (a_x, a_y, a_z are unit vectors along x, y and z axis respectively). The total power passing through a square plate of side 10 cm on plane $x + 2y = 1.0$, is approximately:</p>	D
<p>(a) 42.12 mW (b) 16.85 mW (c) 18.84 mW (d) 8.429 mW</p>		
26	<p>Evaluate $\int_{-\infty}^{\infty} x^4 f(x) dx$, where $f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$, $x \in (-\infty, \infty)$</p>	A
<p>(a) 3 (b) $3\sqrt{\pi}$ (c) $\sqrt{3}\pi$ (d) 3π</p>		

27

The output of a three element co-linear antenna array operating in a free space environment is combined (after appropriate phase shifting) to maximize the signal received from a particular direction as shown in figure.



If the inter-element spacing is half of the signal wavelength and direction of maximum response is 30° from the perpendicular to the array, what are the phases to be applied to each element? Consider the first element as the reference.

(a) $\begin{bmatrix} -\pi/3 & 0 & \pi/3 \end{bmatrix}$

(b) $\begin{bmatrix} -\pi/4 & 0 & \pi/4 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & \pi/2 & \pi \end{bmatrix}$

(d) $\begin{bmatrix} 0 & \pi/4 & \pi \end{bmatrix}$

28

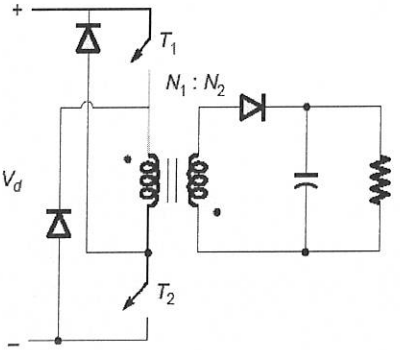
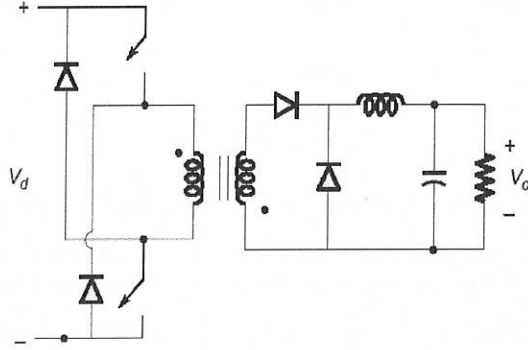
A charge of 2 Coulombs is placed near a grounded conducting plate at a distance of 1 m. The force acting between the charge of 2 C and ground conducting plate in Newton is:

$$\frac{1}{4\pi\epsilon}$$

$$\frac{8\pi\epsilon}{1}$$

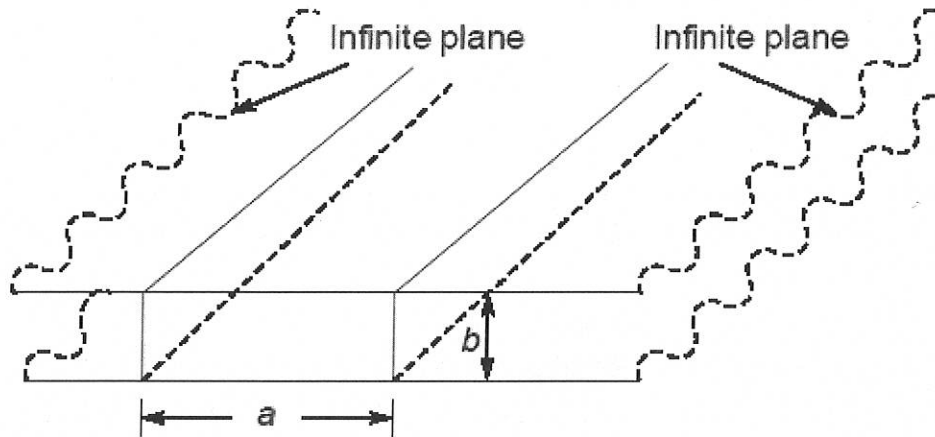
$$\frac{16\pi\epsilon}{1}$$

$$\frac{32\pi\epsilon}{1}$$

29	<p>The system $16/s(s+1)(s+16)$ is to be compensated such that its gain-crossover frequency becomes same as its uncompensated Phase-crossover frequency. Which of the following is the phase crossover frequency of the compensated system?</p> <p>(a) 4 rad/sec (b) 8 rad/sec (c) 16 rad/sec (d) None of the above</p>	a
30	<p>Identify the converter topologies from the figures given below:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(i)</p> </div> <div style="text-align: center;">  <p>(ii)</p> </div> </div> <p>(a) Both are Forward Converters (b) Both are Flyback Converters (c) Flyback Converter (ii) Forward Converter (d) Forward Converter (ii) Flyback Converter</p>	c

31

Two parallel perfectly conducting planes of infinite extent are placed 'b' distance apart so that the cut-off frequency of the lowest order TE mode is 15 GHz. If additionally, two perfectly conducting planes are placed 10 mm apart so as to form a rectangular waveguide as shown in figure. Find the cut-off frequency of TE₁₁ mode.



- (a) 30 GHz
- (b) $15\sqrt{2}$ GHz
- (c) 15 GHz
- (d) $35\sqrt{2}$ GHz

32

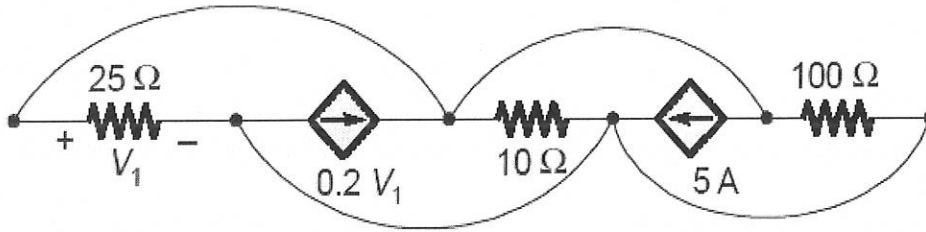
The electric field between two parallel plates placed in vacuum is 'E'. If a slab of dielectric constant 3 is inserted in between the plates such that the normal to the boundary makes an angle 45° with the lines of electric force in between the plates. Find the angle between the electric lines in the medium between the plates (vacuum) and dielectric slab.

- (a) 60°
- (b) 15°
- (c) 30°
- (d) 25°

33

Determine the value of voltage V_1 in the figure shown below.

a

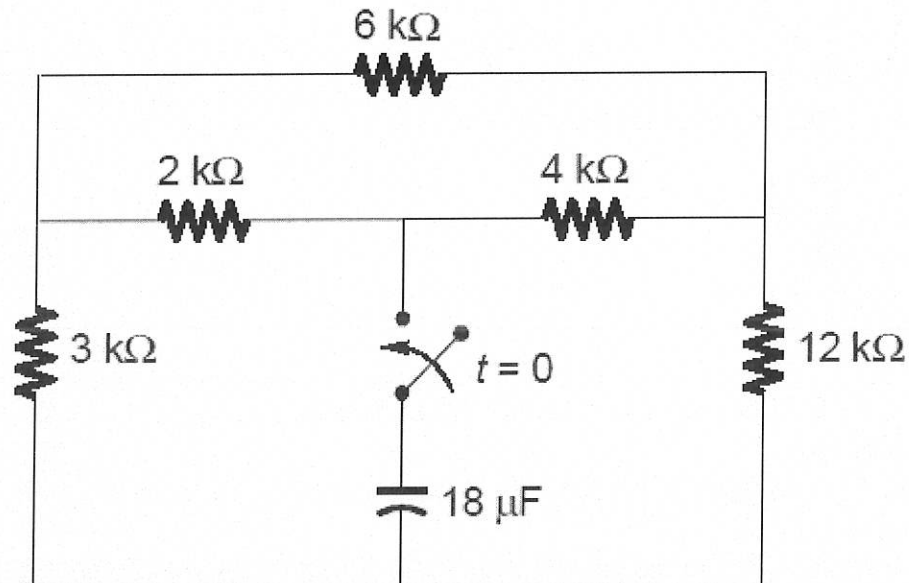
The value of voltage V_1 in volts is

- (a) 100 V
- (b) 14.28 V
- (c) 50 V
- (d) 68.25 V

34

A $18 \mu\text{F}$ capacitor holding charge of Q coulomb is connected to the circuit at time $t = 0$ sec.

c

The time at which the capacitor will be discharged to approximately $Q/2.72$ coulombs.

- (a) 18 ms
- (b) 34 ms
- (c) 68 ms
- (d) 2.72 ms

35

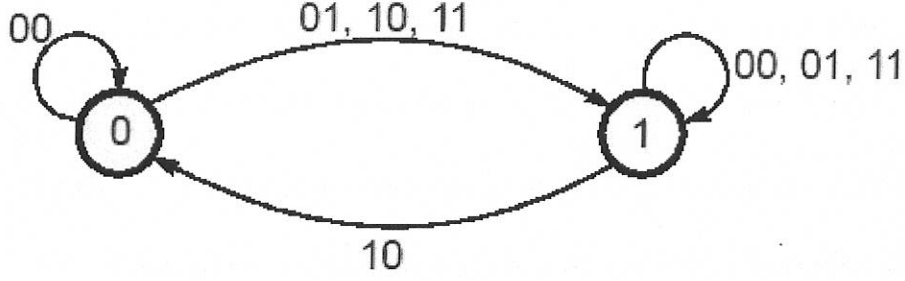
In VHDL, following statement is written a process, where Clock frequency is 24 MHz.

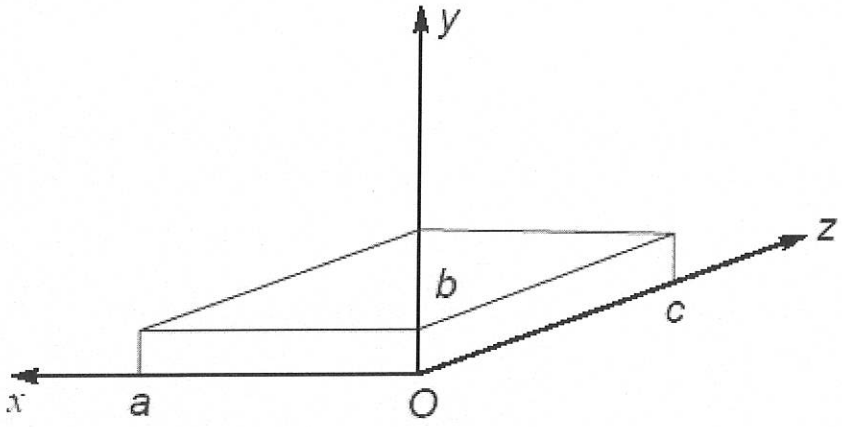
```
If (clock' event and clock = '1') then
  counter_4bit <= counter_4bit + x "1";
End if;
```

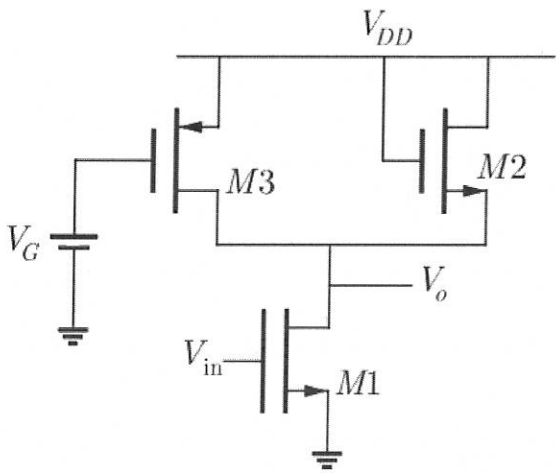
The frequency of counter_4bit (2) will be:

- (a) 12 MHz
- (b) 4 MHz
- (c) 6 MHz
- (d) 3 MHz

d

<p>36</p>	<p>The following state diagram represents which of the input equation. (Given $DA = [A, x, y]$) (Where DA denotes a DFF with output. The x and y are the inputs to the circuit)</p>  <p>(a) $DA = A \oplus x \oplus y$ (b) $DA = A + x \oplus y$ (c) $DA = A \oplus x + y$ (d) $DA = A + x + y$</p>	<p>c</p>
<p>37</p>	<p>A source generates four messages m1, m2, m3 and m4 with probabilities 0.5, 0.25, 0.125 and 0.125 respectively. The messages are generated independently of each other. A source coder assigns binary code to each message. Which of the following codes has minimum average length is also uniquely decodable (sequence as per m1, m2, m3, m4)?</p> <p>(a) 00, 01, 10, 11 (b) 0, 1, 10, 11 (c) 110, 111, 10, 0 (d) 0, 10, 110, 111</p>	<p>d</p>

<p>38</p>	<p>A mobile antenna receives two copies of the signal transmitted by the base station. The first copy is the line-of-sight component and the other is a reflected component which is 20 dB weaker in terms of Power than the LoS component and delayed by 100 ns. If the signal is sufficiently wideband, causing constructive and destructive interference at different frequency points within the signal bandwidth. What will be the ratio of maximum to minimum signal level variation across bandwidth and what will be the frequency separation between two consecutive maxima or minima?</p> <p>(a) 101/99, 10 MHz (b) 101/99, 15 MHz (c) 121/81, 10 MHz (d) 121/81, 15 MHz</p>	<p>a</p>
<p>39</p>	<p>Which of the following is an example of oversampling ADC architecture?</p> <p>(a) Sigma delta (b) Successive approximation (c) Integrator (d) Flash</p>	<p>a</p>
<p>40</p>	<p>Consider the rectangular cavity as shown below: If $a = c > b$, the dominant mode of resonance corresponding to the above rectangular cavity is</p>  <p>(a) TE011 (b) TE101 (c) TM110 (d) TM011</p>	<p>b</p>

41	<p>A video camera generates data at a rate of 5 Mbps. The data is channel coded at rate 1/3 and 8 PSK modulated. Which of the following statements is correct?</p> <p>(a) Information rate: 5 Mbps; Symbol rate: 5 Msps (b) Information rate: 15 Mbps; Symbol rate: 5 Msps (c) Information rate: 15 Mbps; Symbol rate: 15 Msps (d) Information rate: 5 Mbps; Symbol rate: 5 Msps</p>	b
42	<p>In the circuit shown in the figure, the channel length modulation of all transistors is non zero ($\lambda \neq 0$). Also, all transistors operate in saturation and have negligible body effect. The ac small signal voltage gain (V_o/V_{in}) of the circuit is</p>  <p>A) $g_{m1} (r_{o1} \parallel r_{o2} \parallel r_{o3})$ B) $g_{m1} \left[r_{o1} \parallel \left(\frac{1}{g_{m3}} \right) \parallel r_{o3} \right]$ C) $g_{m1} \left[r_{o1} \parallel \left(\frac{1}{g_{m2}} \right) \parallel r_{o2} \parallel r_{o3} \right]$ D) $g_{m1} \left[r_{o1} \parallel \left(\frac{1}{g_{m3}} \right) \parallel r_{o3} \parallel r_{o2} \right]$</p>	C

43	<p>Two boxes containing candies are placed on a table. The boxes are labelled B1 and B2. Box B1 contains 7 cinnamon candies and 4 ginger candies. Box B2 contains 3 cinnamon candies and 10 pepper candies. The boxes are arranged so that the probability of selecting box B1 is $\frac{1}{3}$ and the probability of selecting box B2 is $\frac{2}{3}$. Suresh is blindfolded and asked to select a candy. He will win a colour TV if he selects a cinnamon candy. What is the probability that Suresh will win the TV (that is, he will select a cinnamon candy)?</p> <p>A) $\frac{7}{33}$ B) $\frac{6}{33}$ C) $\frac{13}{33}$ D) $\frac{20}{33}$</p>	C
44	<p>In a direct sequence CDMA system the chip rate is 1.2288×10^6 chips per second. If the processing gain is desired to be at least 100, the data rate:</p> <p>(A) must be less than or equal to 12.288×10^3 bits per sec (B) Must be greater than 12.288×10^3 bits per sec (C) Must be exactly equal to 12.288×10^3 bits per sec (D) Can take any value less than 122.288×10^3 bits per sec</p>	A
45	<p>Poisson equation is derived with the following assumption about the medium. The medium is:</p> <p>(A) non-homogeneous and isotropic (B) non-homogeneous and non-isotropic (C) homogeneous and isotropic (D) homogeneous and non-isotropic</p>	C
46	<p>A weighting function is _____ response of the system.</p> <p>(a) Step (b) Ramp (c) Parabolic (d) Impulse</p>	D
47	<p>According to Rayleigh's theorem, it becomes possible to determine energy of signal by____</p> <p>(A) estimating the area exactly half as that of it's amplitude spectrum (B) estimating the area under square of it's amplitude spectrum (C) estimating the area under one-fourth power of it's amplitude spectrum (D) estimating the area under square root of it's amplitude spectrum</p>	B
48	<p>Which among the below circuits resemble its behaviour similar to that of an amplifier in high frequency region, as the response decreases with increase in frequency?</p> <p>(A) simple band pass circuit (B) Simple high pass circuit (C) Simple low pass circuit (D) Simple band stop circuit</p>	C

49	An impulse response of the system at initially rest condition is basically a response to it's input, and hence regarded as: (A) Green's function (B) Blue's function (C) Ohm's function (D) Black's function	A
50	Damped sinusoids are: (A) sinusoids signals multiplied by growing exponentials (B) sinusoids signals divided by growing exponentials (C) sinusoids signals multiplied by decaying exponentials (D) sinusoids signals divided by decaying exponentials	C

