ELECTRONICHE 2020 PRELIMS

UG I – EVENING SESSION

Section I (For every question, 1 mark for correct answers, -1 for wrong answers) (1x5)

1. A father said to his son, "I was as old as you are at the present at the time of your birth". If the father's age is 38 years now, the son's age five years back was:
   (A)19
   (B)14
   (C)28
   (D)11

2. A batsman scored 110 runs which included 3 boundaries and 8 sixes. What percent of his total score did he make by running between the wickets?

   (A)45
   (B)47
   (C)51
   (D)41

3. From a group of 7 men and 6 women, five persons are to be selected to form a committee so that at least 3 men are there on the committee. In how many ways can it be done?

   (A)126
   (B)108
   (C)756
   (D)512

4. It was Sunday on Jan 1, 2006. What was the day of the week Jan 1, 2010?

   (A)Saturday
   (B)Friday
   (C)Tuesday
   (D) Thursday

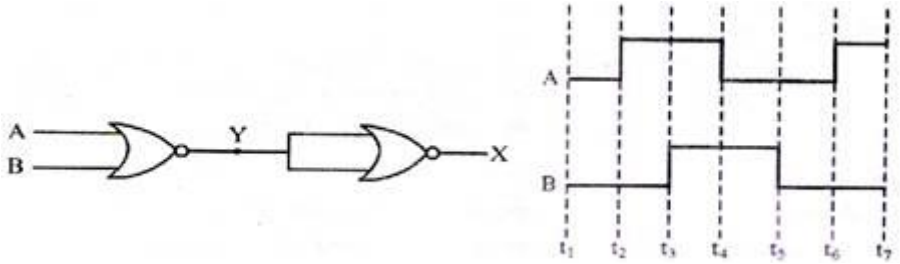
5. A, B, C subscribe Rs. 50,000 for a business. A subscribes Rs. 4000 more than B and B Rs. 5000 more than C. Out of a total profit of Rs. 35,000, A receives:

   (A)14.7k
   (B)14k
   (C)19k
   (D)14.1k

Section II (For every question, 2 marks for correct answers, -0.5 for wrong answers) (2x20)

1. Realize the function AB + C using a 4-to-1 MUX.

2. . Draw the output waveform at X, using the given inputs A and B for the logic circuit shown below. Also, give the truth table of the logic operation performed by this circuit.



3. (A AND B) + (A AND ~B) = _____ Draw truth table.

4. An alternating current generator has an internal resistance Rg and an internal reactance Xg. It is used to supply power to a passive load consisting of a resistance Rg and a reactance X_L. For maximum power to be delivered from the generator to the load, the value of X_L is equal to ____

5. List all possible ways to reduce the resonant frequency in an LCR series circuit with a generator.

6. As the frequency of an ac circuit increases, the current first increases and then decreases. What combination of circuit elements is most likely to comprise the circuit?

7. Draw the effective equivalent circuit of the circuit shown in Fig 7.1, at very high frequencies and find the effective impedance.

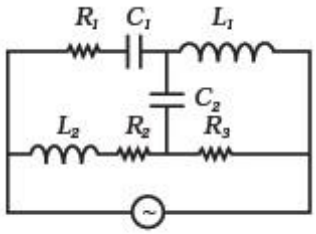
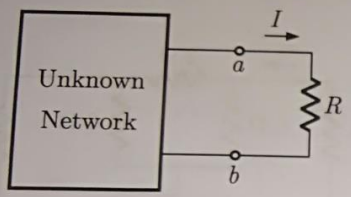


Fig. 7.1

8.

In the following circuit, some measurements were made at the terminals a, b and given in the table below.



R	I
3 Ω	2 A
5 Ω	1.6 A

The Thevenin equivalent of the unknown network across terminal a-b is

(A) 3 Ω, 14 V (B) 5 Ω, 16 V

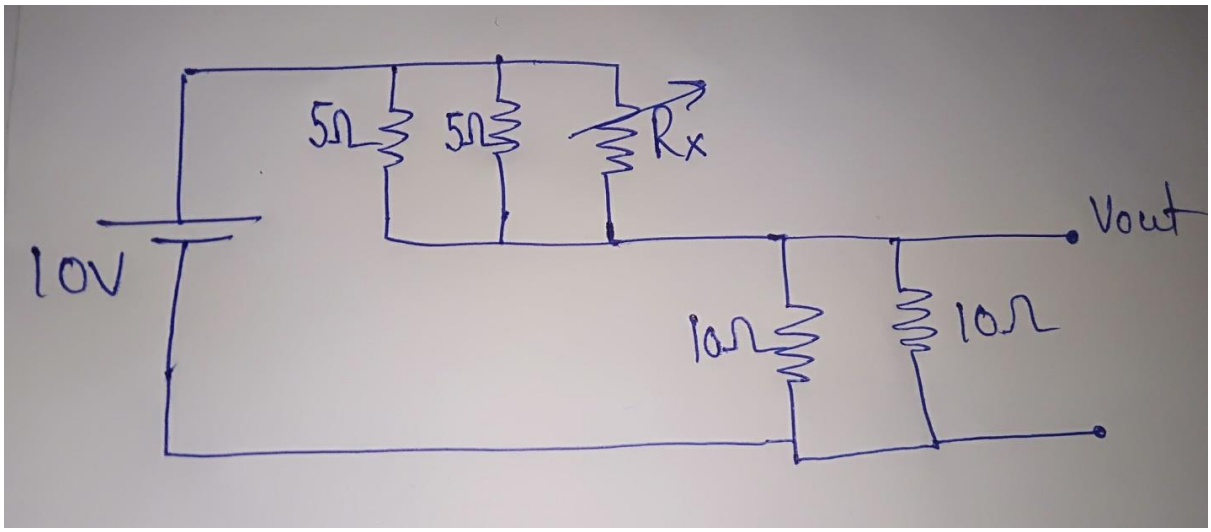
(C) 16 Ω, 38 V (D) 10 Ω, 26 V

The value of R that will cause I to be 1 A, is

(A) 22 Ω (B) 16 Ω

(C) 8 Ω (D) 11 Ω

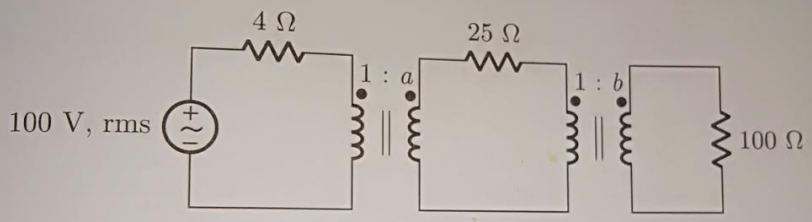
9. For the given circuit below, Resistance Rx is variable and can vary from 0 to 200 ohms. Find out the value of Rx such that maximum power flows through the 10 ohm resistor.



10.

(D) 36 V

Consider the circuit shown below :



If the ideal source supplies 1000 W, half of which is delivered to the 100 Ω load, the value of a and b are

(A) 6, 0.47
(B) 5, 0.89
(C) 0.89, 5
(D) 0.47, 6

11.

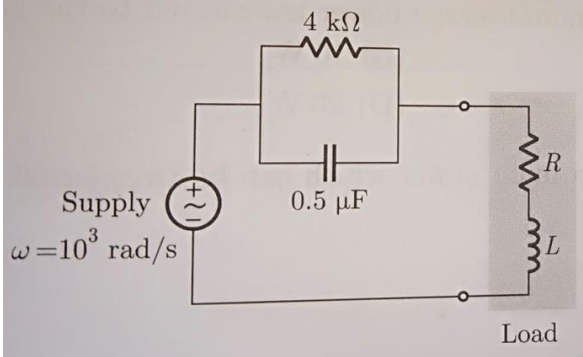
A zener diode has a dc power dissipation rating of 500 mW and a zener voltage rating of 6.8 V. The value of I_{ZM} is

(A) 70 mA
(B) 72 mA
(C) 73.5 mA
(D) 75 mA

12.

(D) 0.50 lagging

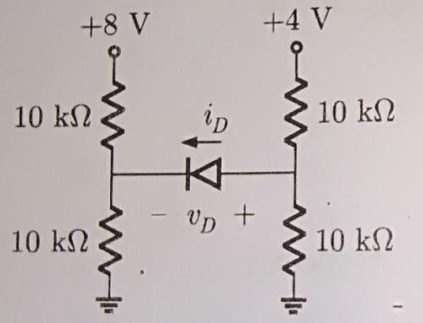
The load in the circuit shown consists of a resistance R and inductance L. What value of R and L maximizes the power transfer to the load ?



(A) 4 kΩ, 2 H
(B) 800 Ω, 1.6 H
(C) 2 kΩ, 1 H
(D) 400 Ω, 0.8 H

13.

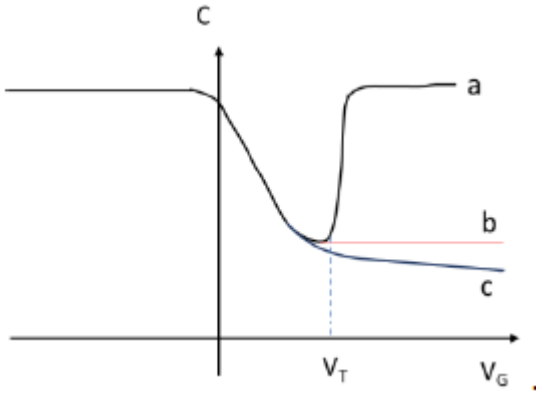
For the circuit in the figure below. The value of v_D is _____volts.



14. In a p-n junction (let N_a=N_d) the peak electric field occurs

A) at the edge of the depletion region on the n-side.
B) at the edge of the depletion region on the p-side.
C) at the centre of the depletion region.
D) at the junction between n and p side.

15.The figure given below shows three different C-V curves for an ideal MOSCAP.

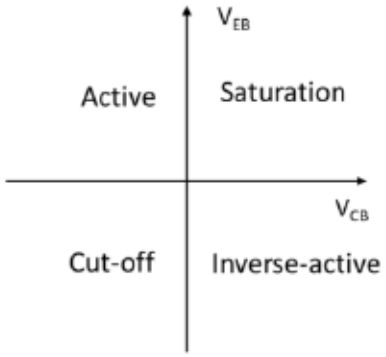


Which of these C-V curves is high frequency C-V curves?

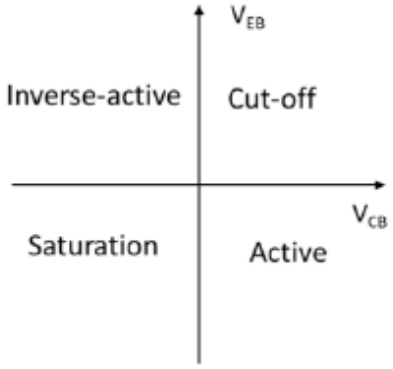
A) c
B) a
C) b & c
D) b

16. Which of the following figures is a correct representation of four biasing modes of p-n-p BJT?

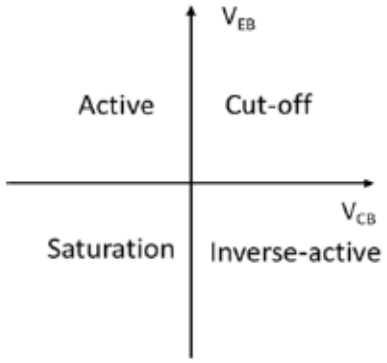
A)



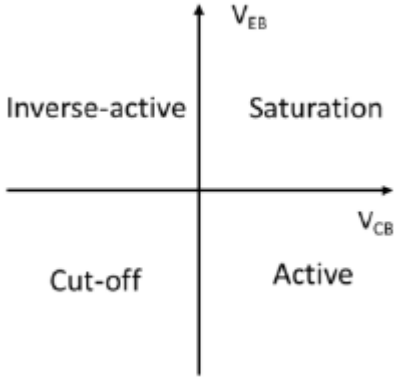
B)



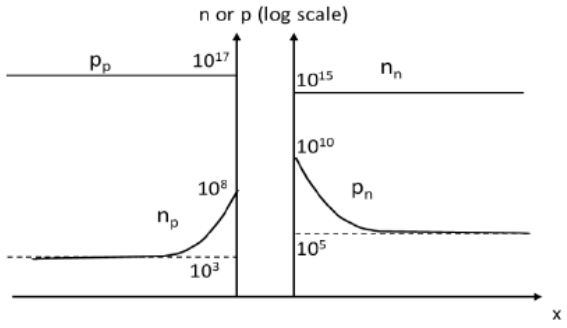
C)



D)



17. The figure shows the steady state carrier concentrations inside Silicon p-n junction diode at 300K

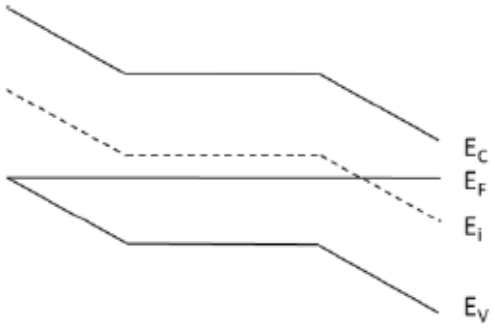


consider the following statements
i. Diode is forward biased.
ii. Diode is reverse biased.
iii. Low-level injection conditions prevail in the quasi-neutral regions of the diode.
iv. High-level injection conditions prevail in the quasi-neutral regions of the diode.
Which of the above statements are correct for the given figure?

A) i and iv.
B) i and iii.
C) ii and iii.

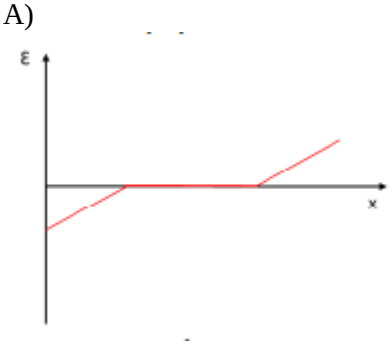
D) ii and iv.

18. Consider the energy band diagram of a Si device maintained at 300K shown below.

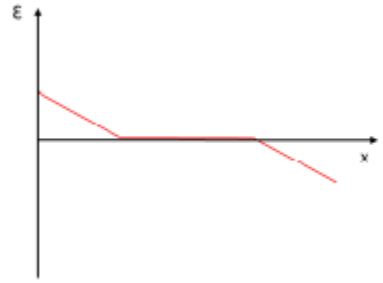


The electric field inside the semiconductor is given by the figure:

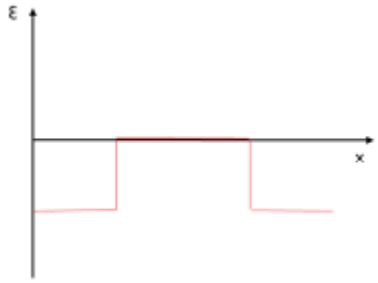
A)



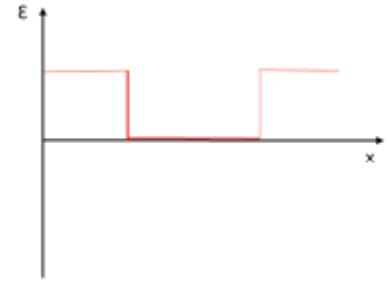
B)



C)



D)



19. In a given semiconductor the probability of electrons occupying the states at an energy 'kT' (k = Boltzmann constant) below the bottom of the conduction band is e^{-10}. The position of the Fermi level in the given material is given by

A) $E_C - E_F = 9kT$.
B) $E_C - E_F = 10kT$.
C) $E_F - E_C = 10kT$.
D) $E_C - E_F = 11kT$.

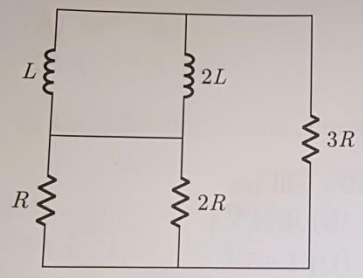
Section III (For every question, 5 marks for correct answers, no negatives)

1. A safe has 5 locks : v, w ,x y & z, all of which must be used to open the safe. The keys to the locks are distributed among 5 executives in the following manner-
   Mr A has keys for locks v & x.
   Mr B has keys for locks v & y.

Mr C has keys for locks w & y.
Mr D has keys for locks z & x.
Mr E has keys for locks v & z.
Write an expression f(A,B,C,D,E) which represents a function of which executives are present to open the safe.

2.

The following circuit has a time constant equals to



(A) $\left(\frac{22}{9}\right)RL$

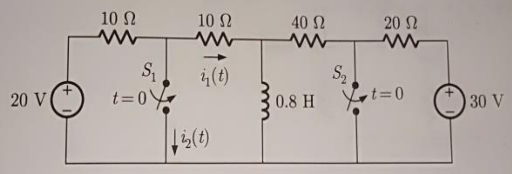
(B) $\left(\frac{2}{11}\right)\frac{L}{R}$

(C) $\left(\frac{11}{9}\right)\frac{L}{R}$

(D) $\left(\frac{11}{2}\right)\frac{R}{L}$

3.

Consider the network shown in the figure below. Both the switches S_1 and S_2 are closed at $t = 0$, after having been open for a long time.



The current $i_1(t)$ for $t > 0$ is given by

(A) $i_1(t) = 1.2e^{-10t}$ A

(B) $i_1(t) = 0.3e^{-10t}$ A

(C) $i_1(t) = 1.5e^{-0.1t}$ A

(D) $i_1(t) = 1.5e^{-10t}$ A

In the circuit above, current $i_2(t)$ through switch S_1 for $t > 0$, is given by

(A) $i_2(t) = (2 - 0.3e^{-10t})$ A

(B) $i_2(t) = 2.4e^{-0.1t}$ A

(C) $i_2(t) = (0.5 + 1.2e^{-10t})$ A

(D) $i_2(t) = (2 - 1.2e^{-10t})$ A

4. Consider two ideal p-n junctions at T=300K, having exactly the same electrical and physical parameters except for the bandgap energy of the semiconductor materials. The first p-n junction has a junction potential of 0.525V and a forward-bias current of 10mA with V_f = 0.255V. For the second p-n junction, “design” the junction potential so that a forward-bias voltage of V_f = 0.32V will produce a current of 10μA. Given $10^{-4}cm^{-2}$, $n_i = 1.5 \times 10^{10}cm^{-3}$ and consider 75% of the total current contribution comes from holes.