






## GATE 2014: General Instructions during Examination

1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

-  You have not visited the question yet.
-  You have not answered the question.
-  You have answered the question.
-  You have NOT answered the question, but have marked the question for review.
-  You have answered the question, but marked it for review.

The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is answered, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

### Navigating to a Question :

7. To answer a question, do the following:
  - a. Click on the question number in the Question Palette to go to that question directly.
  - b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
  - c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
  - d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

**Caution:** Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

### Answering a Question :

8. Procedure for answering a multiple choice (MCQ) type question:
  - a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
  - b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
  - c. To change your chosen answer, click on the bubble of another option.
  - d. To save your answer, you MUST click on the **Save & Next** button.
9. Procedure for answering a numerical answer type question:
  - a. To enter a number as your answer, use the virtual numerical keypad.
  - b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
  - c. To clear your answer, click on the **Clear Response** button.
  - d. To save your answer, you MUST click on the **Save & Next** button
10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is **Marked for Review**, that answer will be considered in the evaluation unless the status is modified by the candidate.*
11. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
12. Note that **ONLY** Questions for which answers are *saved* or *marked for review after answering* will be considered for evaluation.

### Choosing a Section :

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.
14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.
15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. After clicking the **Save & Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.
17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

### Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.
19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.
20. You can shuffle between different Sections or change the optional Sections any number of times.

# GATE 2014 Examination

## EE: Electrical Engineering

Duration: 180 minutes

Maximum Marks: 100

### Read the following instructions carefully.

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.
3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory.  
The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.  
The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.
4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.
5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type (MCQ)** and **numerical answer type**.
9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (○) placed before the choice.
10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices. **For these questions, the answer should be entered** by using the virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of  $\frac{1}{3}$  marks for a 1-mark question and  $\frac{2}{3}$  marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

### Declaration by the candidate:

“I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition”.

**Q. 1 – Q. 5 carry one mark each.**

- Q.1 Which of the following options is the closest in meaning to the phrase underlined in the sentence below?

It is fascinating to see life forms cope with varied environmental conditions.

- (A) adopt to                      (B) adapt to                      (C) adept in                      (D) accept with

- Q.2 Choose the most appropriate word from the options given below to complete the following sentence.

He could not understand the judges awarding her the first prize, because he thought that her performance was quite \_\_\_\_\_.

- (A) superb                      (B) medium                      (C) mediocre                      (D) exhilarating

- Q.3 In a press meet on the recent scam, the minister said, "The buck stops here". What did the minister convey by the statement?

- (A) He wants all the money                      (B) He will return the money  
(C) He will assume final responsibility                      (D) He will resist all enquiries

- Q.4 If  $(z + 1/z)^2 = 98$ , compute  $(z^2 + 1/z^2)$ .

- Q.5 The roots of  $ax^2 + bx + c = 0$  are real and positive.  $a$ ,  $b$  and  $c$  are real. Then  $ax^2 + b|x| + c = 0$  has

- (A) no roots                      (B) 2 real roots  
(C) 3 real roots                      (D) 4 real roots

**Q. 6 – Q. 10 carry two marks each.**

- Q.6 The Palghat Gap (or Palakkad Gap), a region about 30 km wide in the southern part of the Western Ghats in India, is lower than the hilly terrain to its north and south. The exact reasons for the formation of this gap are not clear. It results in the neighbouring regions of Tamil Nadu getting more rainfall from the South West monsoon and the neighbouring regions of Kerala having higher summer temperatures.

What can be inferred from this passage?

- (A) The Palghat gap is caused by high rainfall and high temperatures in southern Tamil Nadu and Kerala  
(B) The regions in Tamil Nadu and Kerala that are near the Palghat Gap are low-lying  
(C) The low terrain of the Palghat Gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala  
(D) Higher summer temperatures result in higher rainfall near the Palghat Gap area

Q.7 Geneticists say that they are very close to confirming the genetic roots of psychiatric illnesses such as depression and schizophrenia, and consequently, that doctors will be able to eradicate these diseases through early identification and gene therapy.

On which of the following assumptions does the statement above rely?

- (A) Strategies are now available for eliminating psychiatric illnesses
- (B) Certain psychiatric illnesses have a genetic basis
- (C) All human diseases can be traced back to genes and how they are expressed
- (D) In the future, genetics will become the only relevant field for identifying psychiatric illnesses

Q.8 Round-trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is Rs 100, a group of 5 tourists purchasing round-trip tickets will be charged Rs \_\_\_\_\_.

Q.9 In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter?

		Men	Women
Own vehicle	Car	40	34
	Scooter	30	20
	Both	60	46
Do not own vehicle		20	50

Q.10 When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines? \_\_\_\_\_

**END OF THE QUESTION PAPER**

**Q. 1 – Q. 25 carry one mark each.**

Q.1 Given a system of equations:

$$\begin{aligned}x + 2y + 2z &= b_1 \\5x + y + 3z &= b_2\end{aligned}$$

Which of the following is true regarding its solutions

- (A) The system has a unique solution for any given  $b_1$  and  $b_2$
- (B) The system will have infinitely many solutions for any given  $b_1$  and  $b_2$
- (C) Whether or not a solution exists depends on the given  $b_1$  and  $b_2$
- (D) The system would have no solution for any values of  $b_1$  and  $b_2$

Q.2 Let  $f(x) = x e^{-x}$ . The maximum value of the function in the interval  $(0, \infty)$  is

- (A)  $e^{-1}$
- (B)  $e$
- (C)  $1 - e^{-1}$
- (D)  $1 + e^{-1}$

Q.3 The solution for the differential equation

$$\frac{d^2x}{dt^2} = -9x,$$

with initial conditions  $x(0) = 1$  and  $\left. \frac{dx}{dt} \right|_{t=0} = 1$ , is

- (A)  $t^2 + t + 1$
- (B)  $\sin 3t + \frac{1}{3} \cos 3t + \frac{2}{3}$
- (C)  $\frac{1}{3} \sin 3t + \cos 3t$
- (D)  $\cos 3t + t$

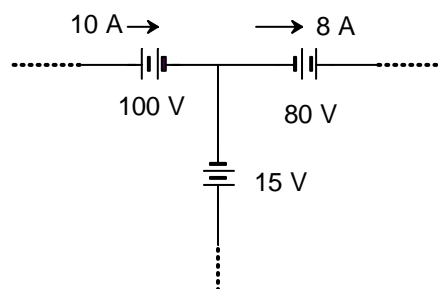
Q.4 Let  $X(s) = \frac{3s+5}{s^2+10s+21}$  be the Laplace Transform of a signal  $x(t)$ . Then,  $x(0^+)$  is

- (A) 0
- (B) 3
- (C) 5
- (D) 21

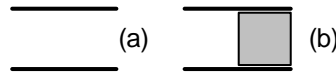
Q.5 Let  $S$  be the set of points in the complex plane corresponding to the unit circle. (That is,  $S = \{z : |z| = 1\}$ ). Consider the function  $f(z) = z z^*$  where  $z^*$  denotes the complex conjugate of  $z$ . The  $f(z)$  maps  $S$  to which one of the following in the complex plane

- (A) unit circle
- (B) horizontal axis line segment from origin to  $(1, 0)$
- (C) the point  $(1, 0)$
- (D) the entire horizontal axis

Q.6 The three circuit elements shown in the figure are part of an electric circuit. The total power absorbed by the three circuit elements in watts is \_\_\_\_\_.



Q.7  $C_0$  is the capacitance of a parallel plate capacitor with air as dielectric (as in figure (a)). If, half of the entire gap as shown in figure (b) is filled with a dielectric of permittivity  $\epsilon_r$ , the expression for the modified capacitance is



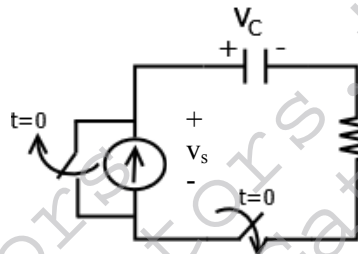
(A)  $\frac{C_0}{2}(1 + \epsilon_r)$

(B)  $(C_0 + \epsilon_r)$

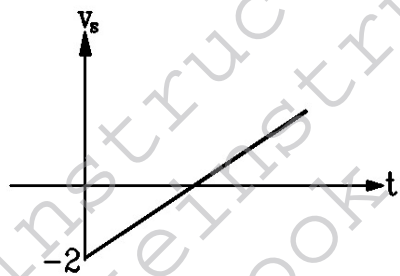
(C)  $\frac{C_0}{2}\epsilon_r$

(D)  $C_0(1 + \epsilon_r)$

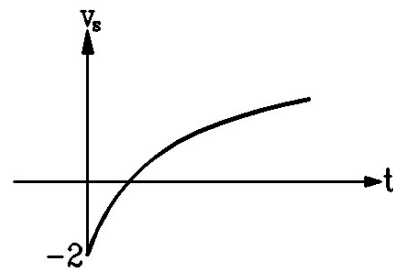
Q.8 A combination of 1  $\mu\text{F}$  capacitor with an initial voltage  $v_c(0) = -2\text{ V}$  in series with a 100  $\Omega$  resistor is connected to a 20 mA ideal dc current source by operating both switches at  $t = 0\text{ s}$  as shown. Which of the following graphs shown in the options approximates the voltage  $v_s$  across the current source over the next few seconds?



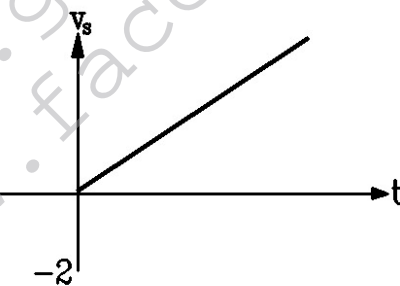
(A)



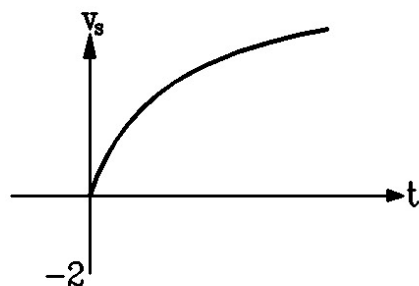
(B)



(C)



(D)

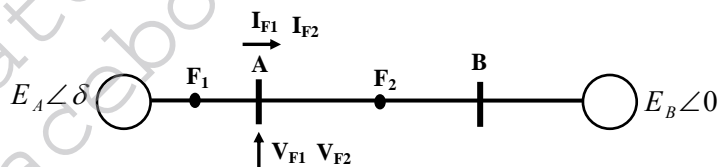


Q.9  $x(t)$  is nonzero only for  $T_x < t < T'_x$ , and similarly,  $y(t)$  is nonzero only for  $T_y < t < T'_y$ . Let  $z(t)$  be convolution of  $x(t)$  and  $y(t)$ . Which one of the following statements is TRUE?

- (A)  $z(t)$  can be nonzero over an unbounded interval.
- (B)  $z(t)$  is nonzero for  $t < T_x + T_y$ .
- (C)  $z(t)$  is zero outside of  $T_x + T_y < t < T'_x + T'_y$ .
- (D)  $z(t)$  is nonzero for  $t > T'_x + T'_y$ .



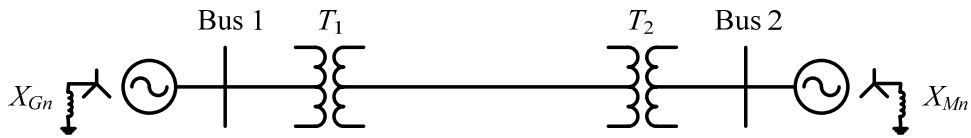
- Q.10 For a periodic square wave, which one of the following statements is TRUE?
- (A) The Fourier series coefficients do not exist.  
 (B) The Fourier series coefficients exist but the reconstruction converges at no point.  
 (C) The Fourier series coefficients exist and the reconstruction converges at most points.  
 (D) The Fourier series coefficients exist and the reconstruction converges at every point.
- Q.11 An 8-pole, 3-phase, 50 Hz induction motor is operating at a speed of 700 rpm. The frequency of the rotor current of the motor in Hz is \_\_\_\_\_.
- Q.12 For a specified input voltage and frequency, if the equivalent radius of the core of a transformer is reduced by half, the factor by which the number of turns in the primary should change to maintain the same no load current is
- (A) 1/4                      (B) 1/2                      (C) 2                      (D) 4
- Q.13 A star connected 400 V, 50 Hz, 4 pole synchronous machine gave the following open circuit and short circuit test results:  
 Open circuit test:  $V_{oc} = 400$  V (rms, line-to-line) at field current,  $I_f = 2.3$  A  
 Short circuit test:  $I_{sc} = 10$  A (rms, phase) at field current,  $I_f = 1.5$  A
- The value of per phase synchronous impedance in  $\Omega$  at rated voltage is \_\_\_\_\_.
- Q.14 The undesirable property of an electrical insulating material is
- (A) high dielectric strength                      (B) high relative permittivity  
 (C) high thermal conductivity                      (D) high insulation resistivity
- Q.15 Three-phase to ground fault takes place at locations  $F_1$  and  $F_2$  in the system shown in the figure



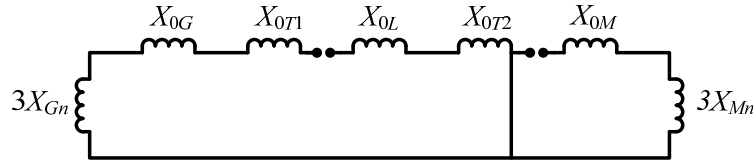
If the fault takes place at location  $F_1$ , then the voltage and the current at bus A are  $V_{F1}$  and  $I_{F1}$  respectively. If the fault takes place at location  $F_2$ , then the voltage and the current at bus A are  $V_{F2}$  and  $I_{F2}$  respectively. The correct statement about voltages and currents during faults at  $F_1$  and  $F_2$  is

- (A)  $V_{F1}$  leads  $I_{F1}$  and  $V_{F2}$  leads  $I_{F2}$   
 (B)  $V_{F1}$  leads  $I_{F1}$  and  $V_{F2}$  lags  $I_{F2}$   
 (C)  $V_{F1}$  lags  $I_{F1}$  and  $V_{F2}$  leads  $I_{F2}$   
 (D)  $V_{F1}$  lags  $I_{F1}$  and  $V_{F2}$  lags  $I_{F2}$

Q.16 A 2-bus system and corresponding zero sequence network are shown in the figure.



(a)



(b)

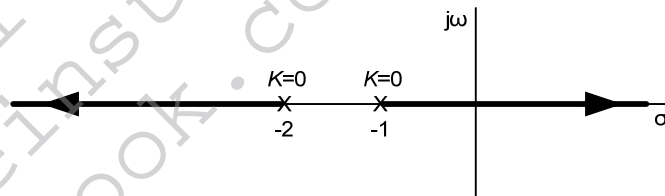
The transformers  $T_1$  and  $T_2$  are connected as

- (A)  $\Delta$   $\Delta$  and  $\Delta$   $\Delta$
- (B)  $\Delta$   $\Delta$  and  $\Delta$   $\Delta$
- (C)  $\Delta$   $\Delta$  and  $\Delta$   $\Delta$
- (D)  $\Delta$   $\Delta$  and  $\Delta$   $\Delta$

Q.17 In the formation of Routh-Hurwitz array for a polynomial, all the elements of a row have zero values. This premature termination of the array indicates the presence of

- (A) only one root at the origin
- (B) imaginary roots
- (C) only positive real roots
- (D) only negative real roots

Q.18 The root locus of a unity feedback system is shown in the figure



The closed loop transfer function of the system is

- (A)  $\frac{C(s)}{R(s)} = \frac{K}{(s+1)(s+2)}$
- (B)  $\frac{C(s)}{R(s)} = \frac{-K}{(s+1)(s+2)+K}$
- (C)  $\frac{C(s)}{R(s)} = \frac{K}{(s+1)(s+2)-K}$
- (D)  $\frac{C(s)}{R(s)} = \frac{K}{(s+1)(s+2)+K}$

Q.19 Power consumed by a balanced 3-phase, 3-wire load is measured by the two wattmeter method. The first wattmeter reads twice that of the second. Then the load impedance angle in radians is

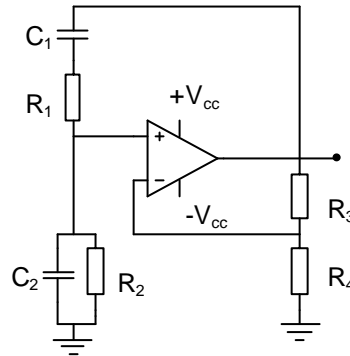
- (A)  $\pi/12$
- (B)  $\pi/8$
- (C)  $\pi/6$
- (D)  $\pi/3$

Q.20 In an oscilloscope screen, linear sweep is applied at the

- (A) vertical axis
- (B) horizontal axis
- (C) origin
- (D) both horizontal and vertical axis

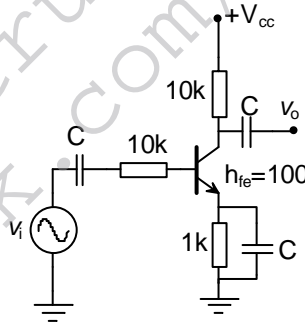
- Q.21 A cascade of three identical modulo-5 counters has an overall modulus of  
 (A) 5 (B) 25 (C) 125 (D) 625

- Q.22 In the Wien Bridge oscillator circuit shown in figure, the bridge is balanced when



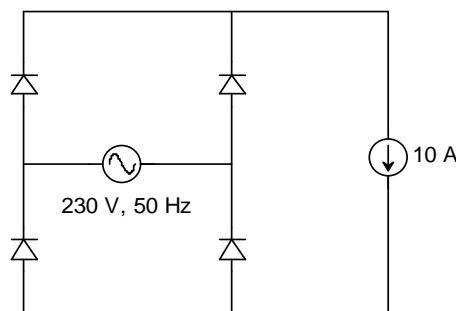
- (A)  $\frac{R_3}{R_4} = \frac{R_1}{R_2}$ ,  $\omega = \frac{1}{\sqrt{R_1 C_1 R_2 C_2}}$  (B)  $\frac{R_2}{R_1} = \frac{C_2}{C_1}$ ,  $\omega = \frac{1}{R_1 C_1 R_2 C_2}$   
 (C)  $\frac{R_3}{R_4} = \frac{R_1}{R_2} + \frac{C_2}{C_1}$ ,  $\omega = \frac{1}{\sqrt{R_1 C_1 R_2 C_2}}$  (D)  $\frac{R_3}{R_4} + \frac{R_1}{R_2} = \frac{C_2}{C_1}$ ,  $\omega = \frac{1}{R_1 C_1 R_2 C_2}$

- Q.23 The magnitude of the mid-band voltage gain of the circuit shown in figure is (assuming  $h_{fe}$  of the transistor to be 100)

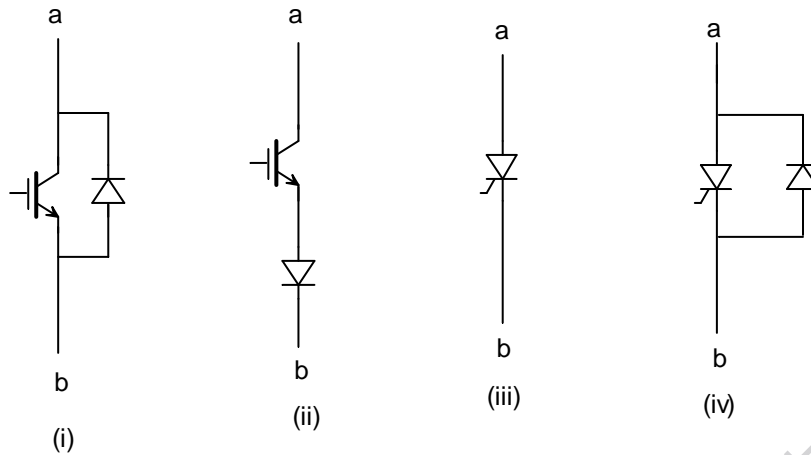


- (A) 1 (B) 10 (C) 20 (D) 100

- Q.24 The figure shows the circuit of a rectifier fed from a 230-V (rms), 50-Hz sinusoidal voltage source. If we want to replace the current source with a resistor so that the rms value of the current supplied by the voltage source remains unchanged, the value of the resistance (in ohms) is \_\_\_\_\_ (Assume diodes to be ideal.)



Q.25 Figure shows four electronic switches (i), (ii), (iii) and (iv). Which of the switches can block voltages of either polarity (applied between terminals ‘a’ and ‘b’) when the active device is in the OFF state?



- (A) (i), (ii) and (iii)
- (B) (ii), (iii) and (iv)
- (C) (ii) and (iii)
- (D) (i) and (iv)

**Q. 26 – Q. 55 carry two marks each.**

Q.26 Let  $g: [0, \infty) \rightarrow [0, \infty)$  be a function defined by  $g(x) = x - [x]$ , where  $[x]$  represents the integer part of  $x$ . (That is, it is the largest integer which is less than or equal to  $x$ ). The value of the constant term in the Fourier series expansion of  $g(x)$  is \_\_\_\_\_

Q.27 A fair coin is tossed  $n$  times. The probability that the difference between the number of heads and tails is  $(n-3)$  is

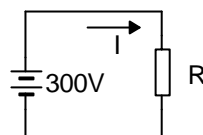
- (A)  $2^{-n}$
- (B) 0
- (C)  ${}^nC_{n-3}2^{-n}$
- (D)  $2^{-n+3}$

Q.28 The line integral of function  $\mathbf{F} = yz\mathbf{i}$ , in the counterclockwise direction, along the circle  $x^2+y^2=1$  at  $z=1$  is

- (A)  $-2\pi$
- (B)  $-\pi$
- (C)  $\pi$
- (D)  $2\pi$

Q.29 An incandescent lamp is marked 40 W, 240V. If resistance at room temperature ( $26^\circ\text{C}$ ) is  $120 \Omega$ , and temperature coefficient of resistance is  $4.5 \times 10^{-3}/^\circ\text{C}$ , then its ‘ON’ state filament temperature in  $^\circ\text{C}$  is approximately \_\_\_\_\_

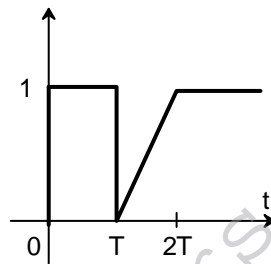
Q.30 In the figure, the value of resistor R is  $(25 + I/2)$  ohms, where I is the current in amperes. The current I is \_\_\_\_\_



- Q.31 In an unbalanced three phase system, phase current  $I_a = 1\angle(-90^\circ)$  pu, negative sequence current  $I_{b2} = 4\angle(-150^\circ)$  pu, zero sequence current  $I_{c0} = 3\angle 90^\circ$  pu. The magnitude of phase current  $I_b$  in pu is
- (A) 1.00                      (B) 7.81                      (C) 11.53                      (D) 13.00

- Q.32 The following four vector fields are given in Cartesian co-ordinate system. The vector field which does not satisfy the property of magnetic flux density is
- (A)  $y^2\mathbf{a}_x + z^2\mathbf{a}_y + x^2\mathbf{a}_z$                       (B)  $z^2\mathbf{a}_x + x^2\mathbf{a}_y + y^2\mathbf{a}_z$   
 (C)  $x^2\mathbf{a}_x + y^2\mathbf{a}_y + z^2\mathbf{a}_z$                       (D)  $y^2z^2\mathbf{a}_x + x^2z^2\mathbf{a}_y + x^2y^2\mathbf{a}_z$

- Q.33 The function shown in the figure can be represented as



- (A)  $u(t) - u(t - T) + \frac{(t-T)}{T}u(t - T) - \frac{(t-2T)}{T}u(t - 2T)$   
 (B)  $u(t) + \frac{t}{T}u(t - T) - \frac{t}{T}u(t - 2T)$   
 (C)  $u(t) - u(t - T) + \frac{(t-T)}{T}u(t) - \frac{(t-2T)}{T}u(t)$   
 (D)  $u(t) + \frac{(t-T)}{T}u(t - T) - 2\frac{(t-2T)}{T}u(t - 2T)$
- Q.34 Let  $X(z) = \frac{1}{1-z^{-3}}$  be the Z-transform of a causal signal  $x[n]$ . Then, the values of  $x[2]$  and  $x[3]$  are
- (A) 0 and 0                      (B) 0 and 1                      (C) 1 and 0                      (D) 1 and 1

- Q.35 Let  $f(t)$  be a continuous time signal and let  $F(\omega)$  be its Fourier Transform defined by

$$F(\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t} dt$$

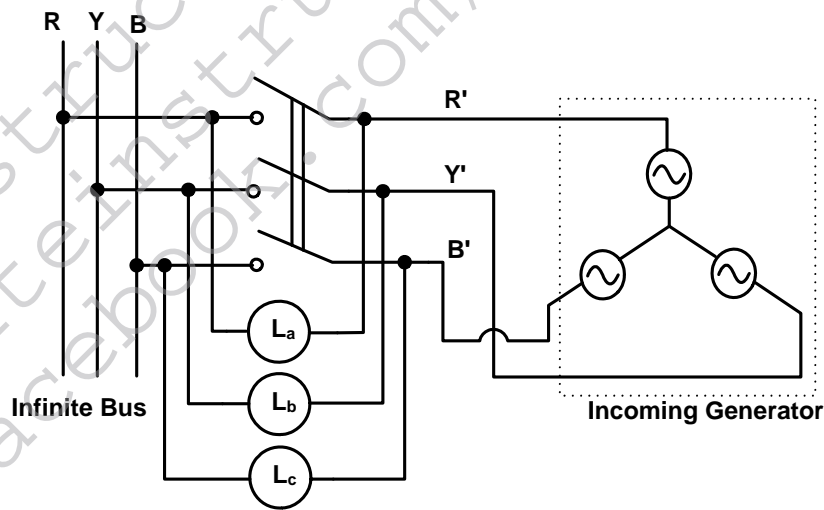
Define  $g(t)$  by

$$g(t) = \int_{-\infty}^{\infty} F(u)e^{-jut} du$$

What is the relationship between  $f(t)$  and  $g(t)$  ?

- (A)  $g(t)$  would always be proportional to  $f(t)$ .  
 (B)  $g(t)$  would be proportional to  $f(t)$  if  $f(t)$  is an even function.  
 (C)  $g(t)$  would be proportional to  $f(t)$  only if  $f(t)$  is a sinusoidal function.  
 (D)  $g(t)$  would never be proportional to  $f(t)$ .

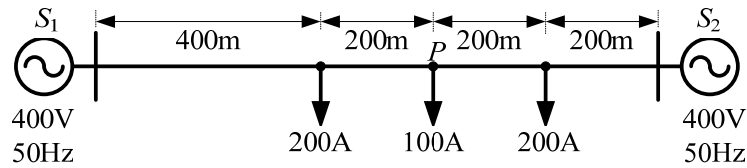
- Q.36 The core loss of a single phase, 230/115 V, 50 Hz power transformer is measured from 230 V side by feeding the primary (230 V side) from a variable voltage variable frequency source while keeping the secondary open circuited. The core loss is measured to be 1050 W for 230 V, 50 Hz input. The core loss is again measured to be 500 W for 138 V, 30 Hz input. The hysteresis and eddy current losses of the transformer for 230 V, 50 Hz input are respectively,
- (A) 508 W and 542 W. (B) 468 W and 582 W.  
 (C) 498 W and 552 W. (D) 488 W and 562 W.
- Q.37 A 15 kW, 230 V dc shunt motor has armature circuit resistance of  $0.4 \Omega$  and field circuit resistance of  $230 \Omega$ . At no load and rated voltage, the motor runs at 1400 rpm and the line current drawn by the motor is 5 A. At full load, the motor draws a line current of 70 A. Neglect armature reaction. The full load speed of the motor in rpm is \_\_\_\_\_.
- Q.38 A 3 phase, 50 Hz, six pole induction motor has a rotor resistance of  $0.1 \Omega$  and reactance of  $0.92 \Omega$ . Neglect the voltage drop in stator and assume that the rotor resistance is constant. Given that the full load slip is 3%, the ratio of maximum torque to full load torque is
- (A) 1.567 (B) 1.712 (C) 1.948 (D) 2.134
- Q.39 A three phase synchronous generator is to be connected to the infinite bus. The lamps are connected as shown in the figure for the synchronization. The phase sequence of bus voltage is R-Y-B and that of incoming generator voltage is R'-Y'-B'.



It was found that the lamps are becoming dark in the sequence  $L_a-L_b-L_c$ . It means that the phase sequence of incoming generator is

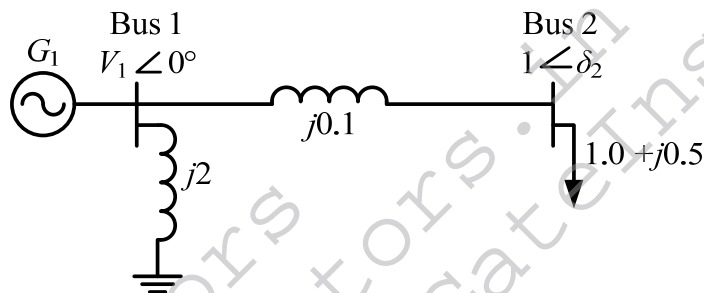
- (A) opposite to infinite bus and its frequency is more than infinite bus  
 (B) opposite to infinite bus but its frequency is less than infinite bus  
 (C) same as infinite bus and its frequency is more than infinite bus  
 (D) same as infinite bus and its frequency is less than infinite bus

Q.40 A distribution feeder of 1 km length having resistance, but negligible reactance, is fed from both the ends by 400V, 50 Hz balanced sources. Both voltage sources  $S_1$  and  $S_2$  are in phase. The feeder supplies concentrated loads of unity power factor as shown in the figure.



The contributions of  $S_1$  and  $S_2$  in 100 A current supplied at location P respectively, are  
 (A) 75 A and 25 A (B) 50 A and 50 A (C) 25 A and 75 A (D) 0 A and 100 A

Q.41 A two bus power system shown in the figure supplies load of  $1.0+j0.5$  p.u.



The values of  $V_1$  in p.u. and  $\delta_2$  respectively are  
 (A) 0.95 and  $6.00^\circ$  (B) 1.05 and  $-5.44^\circ$  (C) 1.1 and  $-6.00^\circ$  (D) 1.1 and  $-27.12^\circ$

Q.42 The fuel cost functions of two power plants are

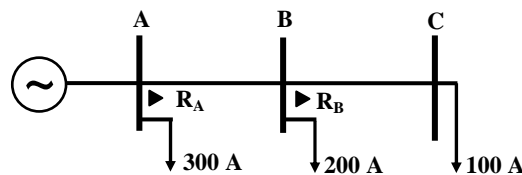
Plant  $P_1$ :  $C_1 = 0.05P_{g1}^2 + AP_{g1} + B$

Plant  $P_2$ :  $C_2 = 0.10P_{g2}^2 + 3AP_{g2} + 2B$

where,  $P_{g1}$  and  $P_{g2}$  are the generated powers of two plants, and  $A$  and  $B$  are the constants. If the two plants optimally share 1000 MW load at incremental fuel cost of 100 Rs/MWh, the ratio of load shared by plants  $P_1$  and  $P_2$  is

(A) 1:4 (B) 2:3 (C) 3:2 (D) 4:1

Q.43 The overcurrent relays for the line protection and loads connected at the buses are shown in the figure.

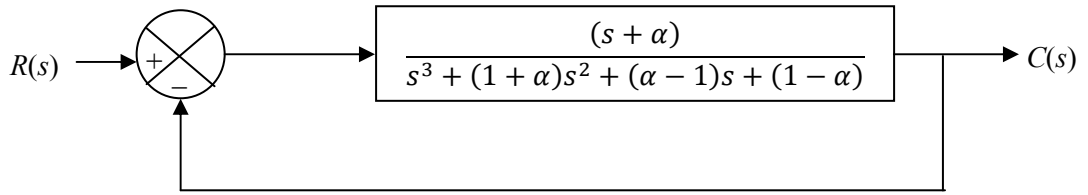


The relays are IDMT in nature having the characteristic

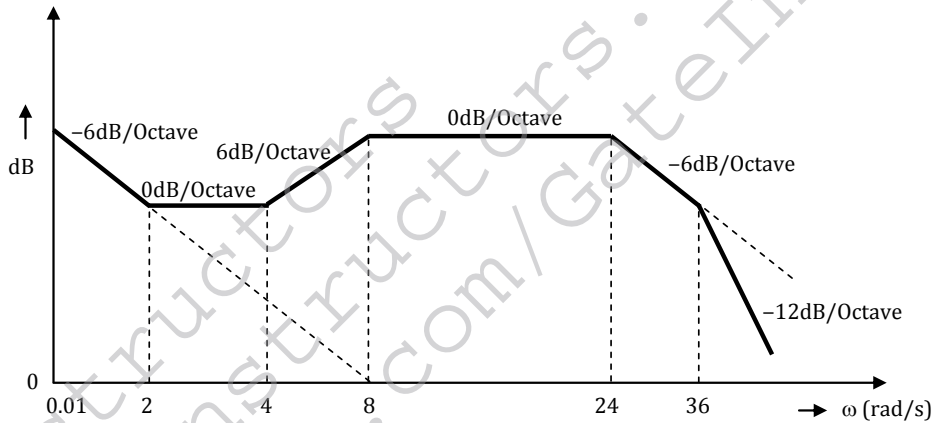
$$t_{op} = \frac{0.14 \times \text{Time Multiplier Setting}}{(\text{Plug Setting Multiplier})^{0.02} - 1}$$

The maximum and minimum fault currents at bus B are 2000 A and 500 A respectively. Assuming the time multiplier setting and plug setting for relay  $R_B$  to be 0.1 and 5A respectively, the operating time of  $R_B$  (in seconds) is \_\_\_\_\_

Q.44 For the given system, it is desired that the system be stable. The minimum value of  $\alpha$  for this condition is \_\_\_\_\_.



Q.45 The Bode magnitude plot of the transfer function  $G(s) = \frac{K(1+0.5s)(1+as)}{s(1+\frac{s}{8})(1+bs)(1+\frac{s}{36})}$  is shown below:  
 Note that  $-6 \text{ dB/octave} = -20 \text{ dB/decade}$ . The value of  $\frac{a}{bK}$  is \_\_\_\_\_.



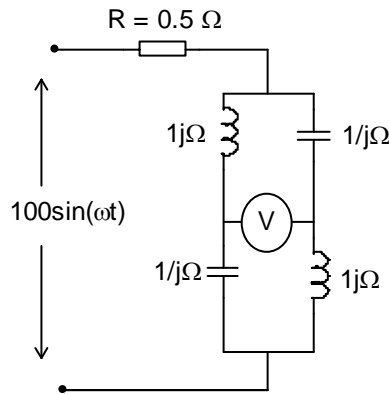
Q.46 A system matrix is given as follows.

$$A = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & 6 \\ -6 & -11 & 5 \end{bmatrix}$$

The absolute value of the ratio of the maximum eigenvalue to the minimum eigenvalue is \_\_\_\_\_

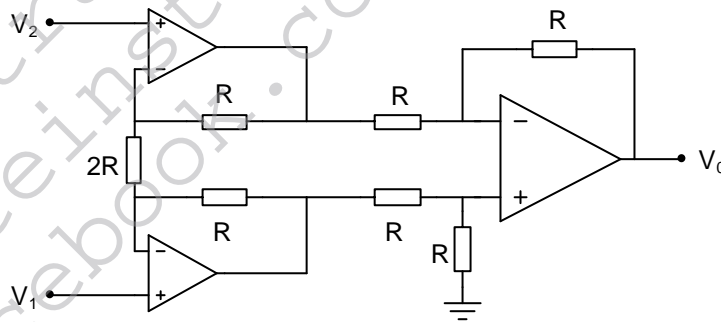


Q.47 The reading of the voltmeter (rms) in volts, for the circuit shown in the figure is \_\_\_\_\_



Q.48 The dc current flowing in a circuit is measured by two ammeters, one PMMC and another electro-dynamometer type, connected in series. The PMMC meter contains 100 turns in the coil, the flux density in the air gap is  $0.2 \text{ Wb/m}^2$ , and the area of the coil is  $80 \text{ mm}^2$ . The electro-dynamometer ammeter has a change in mutual inductance with respect to deflection of  $0.5 \text{ mH/deg}$ . The spring constants of both the meters are equal. The value of current, at which the deflections of the two meters are same, is \_\_\_\_\_

Q.49 Given that the op-amps in the figure are ideal, the output voltage  $V_0$  is

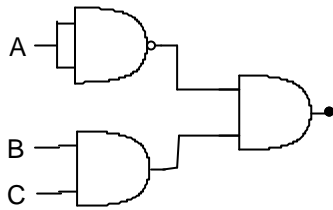


- (A)  $(V_1 - V_2)$
- (B)  $2(V_1 - V_2)$
- (C)  $(V_1 - V_2)/2$
- (D)  $(V_1 + V_2)$

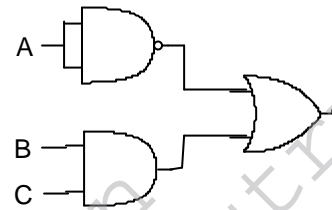
Q.50 Which of the following logic circuits is a realization of the function F whose Karnaugh map is shown in figure

		AB			
		00	01	11	10
C	0	1	1		
	1		1	1	

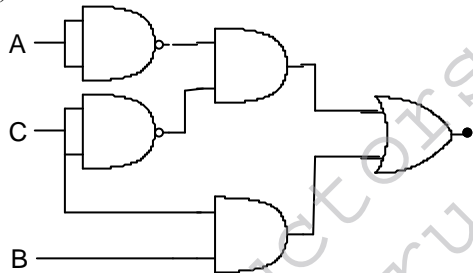
(A)



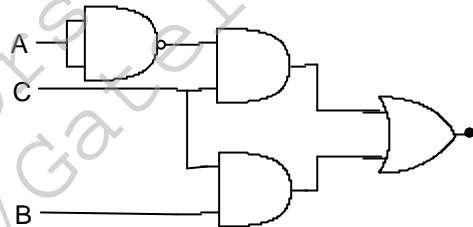
(B)



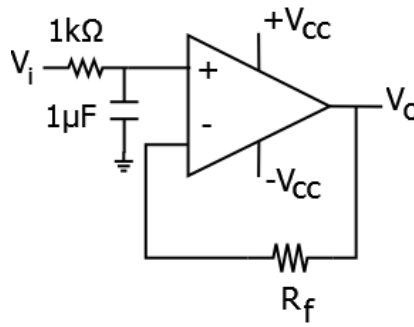
(C)



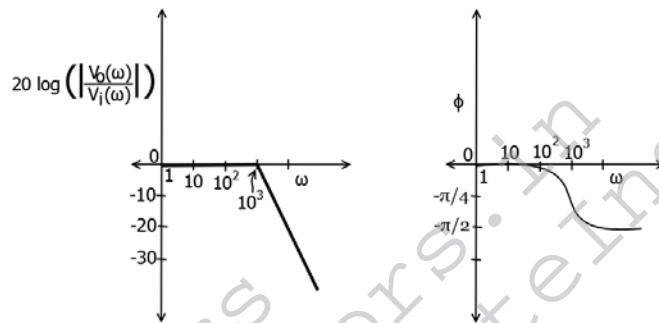
(D)



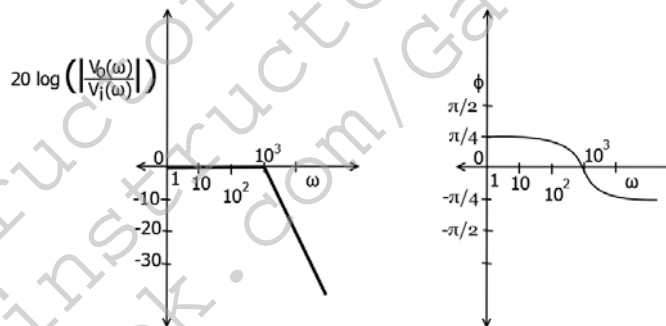
Q.51 In the figure shown, assume the op-amp to be ideal. Which of the alternatives gives the correct Bode plots for the transfer function  $\frac{V_o(\omega)}{V_i(\omega)}$  ?



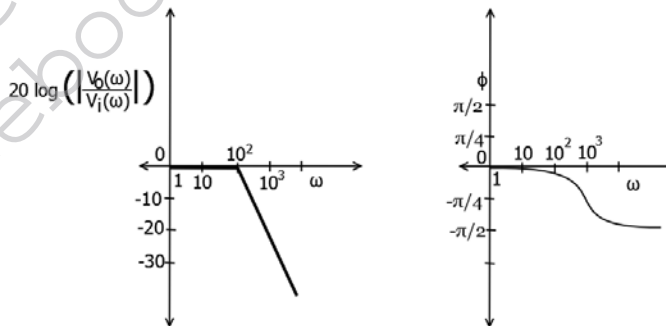
(A)



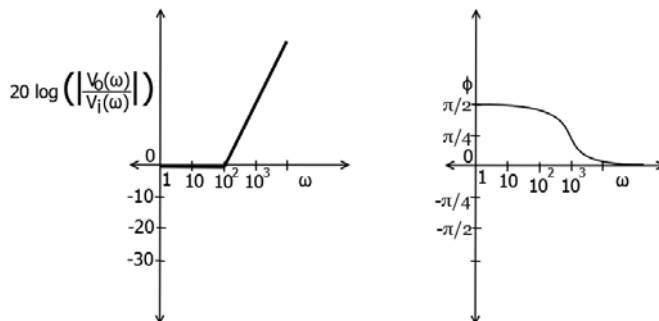
(B)



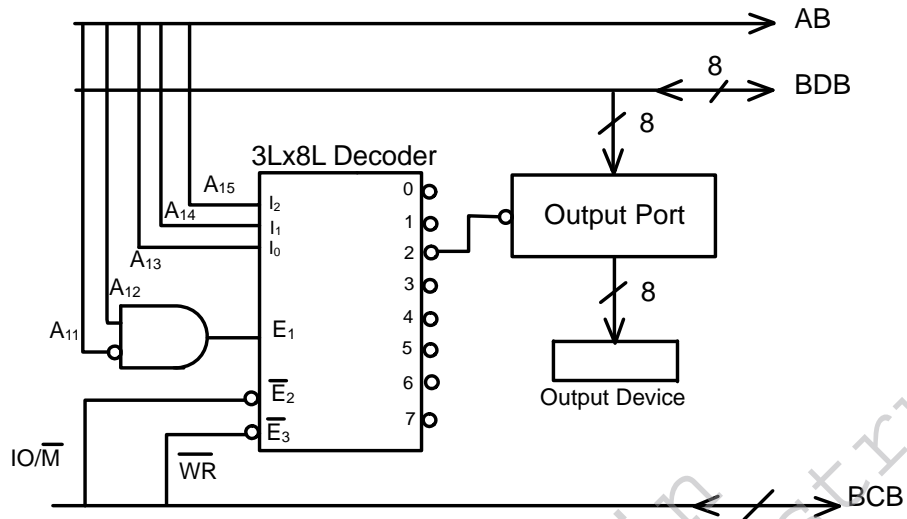
(C)



(D)



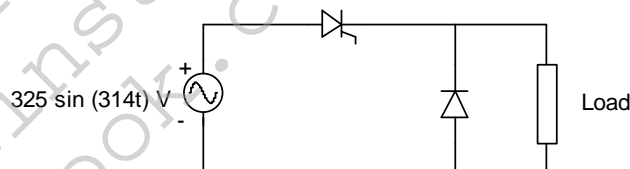
Q.52 An output device is interfaced with 8-bit microprocessor 8085A. The interfacing circuit is shown in figure



The interfacing circuit makes use of 3 Line to 8 Line decoder having 3 enable lines  $E_1, \bar{E}_2, \bar{E}_3$ . The address of the device is

- (A)  $50_H$
- (B)  $5000_H$
- (C)  $A0_H$
- (D)  $A000_H$

Q.53 The figure shows the circuit diagram of a rectifier. The load consists of a resistance  $10 \Omega$  and an inductance  $0.05 H$  connected in series. Assuming ideal thyristor and ideal diode, the thyristor firing angle (in degree) needed to obtain an average load voltage of  $70 V$  is \_\_\_\_\_



Q.54 Figure (i) shows the circuit diagram of a chopper. The switch  $S$  in the circuit in figure (i) is switched such that the voltage  $v_D$  across the diode has the wave shape as shown in figure (ii). The capacitance  $C$  is large so that the voltage across it is constant. If switch  $S$  and the diode are ideal, the peak to peak ripple (in A) in the inductor current is \_\_\_\_\_

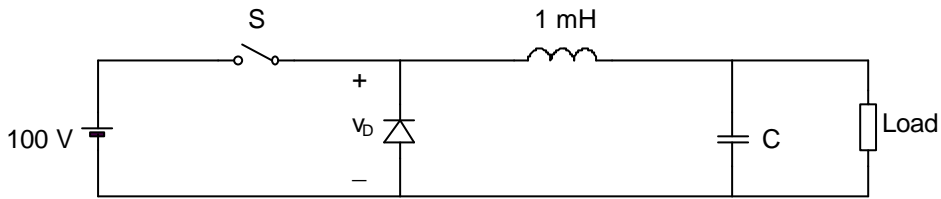


Figure (i)

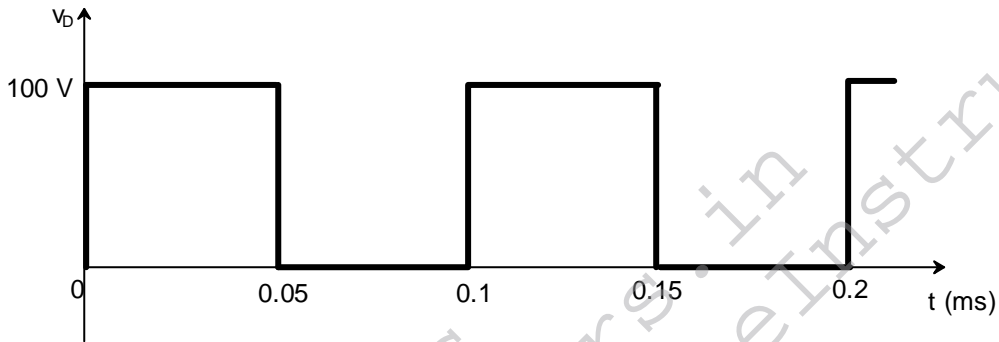
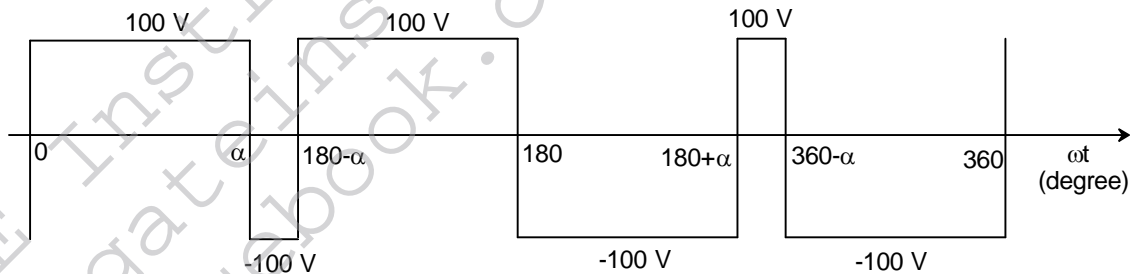


Figure (ii)

Q.55 The figure shows one period of the output voltage of an inverter.  $\alpha$  should be chosen such that  $60^\circ < \alpha < 90^\circ$ . If rms value of the fundamental component is 50 V, then  $\alpha$  in degree is \_\_\_\_\_



**END OF THE QUESTION PAPER**