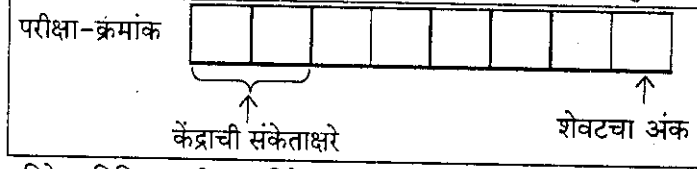




सूचना

(1) सदर प्रश्नपुस्तिकेत 80 अनिवार्य प्रश्न आहेत. उमेदवारांनी प्रश्नांची उत्तरे लिहिण्यास सुरुवात करण्यापूर्वी या प्रश्नपुस्तिकेत सर्व प्रश्न आहेत किंवा नाहीत याची खात्री करून घ्यावी. असा तसेच अन्य काही दोष आढळल्यास ही प्रश्नपुस्तिका समवेक्षकांकडून लगेच बदलून घ्यावी.



(2) आपला परीक्षा-क्रमांक ह्या चौकोनांत न विसरता बॉलपेनने लिहावा.

(3) वर छापलेला प्रश्नपुस्तिका क्रमांक तुमच्या उत्तरपत्रिकेवर विशिष्ट जागी उत्तरपत्रिकेवरील सूचनेप्रमाणे न विसरता नमूद करावा.

(4) या प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाला 4 पर्यायी उत्तरे सुचविली असून त्यांना 1, 2, 3 आणि 4 असे क्रमांक दिलेले आहेत. त्या चार उत्तरपत्रिकेतील सर्वात योग्य उत्तराचा क्रमांक उत्तरपत्रिकेवरील सूचनेप्रमाणे तुमच्या उत्तरपत्रिकेवर नमूद करावा. अशा प्रकारे उत्तरपत्रिकेवर उत्तरक्रमांक नमूद करताना तो संबंधित प्रश्नक्रमांकासमोर छायांकित करून दर्शविला जाईल याची काळजी घ्यावी. ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.

(5) सर्व प्रश्नांना समान गुण आहेत. यास्तव सर्व प्रश्नांची उत्तरे द्यावीत. घाईमुळे चुका होणार नाहीत याची दक्षता घेऊनच शक्य तितक्या वेगाने प्रश्न सोडवावेत. क्रमाने प्रश्न सोडविणे श्रेयस्कर आहे पण एखादा प्रश्न कठीण वाटल्यास त्यावर वेळ न घालविता पुढील प्रश्नाकडे वळावे. अशा प्रकारे शेवटच्या प्रश्नापर्यंत पोहोचल्यानंतर वेळ शिल्लक राहिल्यास कठीण म्हणून वगळलेल्या प्रश्नांकडे परतणे सोईस्कर ठरेल.

(6) उत्तरपत्रिकेत एकदा नमूद केलेले उत्तर खोडता येणार नाही. नमूद केलेले उत्तर खोडून नव्याने उत्तर दिल्यास ते तपासले जाणार नाही.

(7) प्रस्तुत परीक्षेच्या उत्तरपत्रिकांचे मूल्यांकन करताना उमेदवारांच्या उत्तरपत्रिकेतील योग्य उत्तरांनाच गुण दिले जातील. तसेच "उमेदवाराने वस्तुनिष्ठ बहुपर्यायी स्वरूपाच्या प्रश्नांची दिलेल्या चार उत्तरपत्रिकेतील सर्वात योग्य उत्तरेच उत्तरपत्रिकेत नमूद करावीत. अन्यथा त्यांच्या उत्तरपत्रिकेत सोडविलेल्या प्रत्येक चार चुकीच्या उत्तरांसाठी एका प्रश्नाचे गुण वजा करण्यात येतील".

(8) (अ) प्रस्तुत परीक्षेसाठी Non-programmable Scientific calculator वापरण्यास परवानगी आहे.

(ब) उमेदवाराने परीक्षा कक्षात आणलेल्या calculator चा सिरीज क्रमांक हजेरीपटावर नमूद करावा.

(क) उमेदवाराने परीक्षेत programmable calculator वापरल्याचे आढळल्यास त्याची उमेदवारी रद्द करण्यात येईल.

ताकीद

ह्या प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपेपर्यंत ही प्रश्नपुस्तिका आयोगाची मालमत्ता असून ती परीक्षाकक्षात उमेदवाराला परीक्षेसाठी वापरण्यास देण्यात येत आहे. ही वेळ संपेपर्यंत सदर प्रश्नपुस्तिकेची प्रत/प्रती, किंवा सदर प्रश्नपुस्तिकेतील काही आशय कोणत्याही स्वरूपात प्रत्यक्ष वा अप्रत्यक्षपणे कोणत्याही व्यक्तीस पुरविणे, तसेच प्रसिद्ध करणे हा गुन्हा असून अशी कृती करणाऱ्या व्यक्तीवर शासनाने जारी केलेल्या "परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचा अधिनियम-82" यातील तरतुदीनुसार तसेच प्रचलित कायद्याच्या तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षांच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.

तसेच ह्या प्रश्नपत्रिकेसाठी विहित केलेली वेळ संपण्याआधी ही प्रश्नपुस्तिका अनधिकृतपणे बाळगणे हा सुद्धा गुन्हा असून तसे करणारी व्यक्ती आयोगाच्या कर्मचारीवृंदापैकी, तसेच परीक्षेच्या पर्यवेक्षकीयवृंदापैकी असली तरीही अशा व्यक्तीविरुद्ध उक्त अधिनियमानुसार कारवाई करण्यात येईल व दोषी व्यक्ती शिक्षेस पात्र होईल.

पुढील सूचना प्रश्नपुस्तिकेच्या शेवटच्या पानावर पहा

पर्यवेक्षकांच्या सूचनेबिना हे सील उघडू नये

SEAL



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1. Gauss's divergence theorem is

$$(1) \iint_S \vec{F} \cdot \hat{n} \, ds = \iiint_V \text{div} \vec{F} \, dv$$

$$(2) \iint_S \vec{F} \cdot \hat{n} \, ds = \iiint_S \text{curl} \vec{F} \, dv$$

$$(3) \oint_C \vec{F} \cdot d\vec{r} = \iiint_V \text{curl} \vec{F} \cdot \hat{n} \, ds$$

(4) None of the above

2. The value of $\oint_C [(xy + y^2) dx + x^2 dy]$ by Green's theorem is _____, where C is closed curve of the region bounded by $y = x$ and $y = x^2$.

$$(1) -\frac{1}{200}$$

$$(2) -\frac{1}{20}$$

$$(3) -\frac{1}{10}$$

(4) None

3. The value of an improper integral $\int_0^{\infty} \frac{1}{1+x^4} dx =$

$$(1) \frac{\pi}{2\sqrt{2}}$$

$$(2) \frac{\pi}{2}$$

$$(3) \pi\sqrt{2}$$

$$(4) \pi$$

4. Which of the following differential equation is linear ?

$$(1) (y + x)y' + y = 1$$

$$(2) 3y' + (x + 4)y = x^2 + y''$$

$$(3) y''' = \cos(2 + y)$$

$$(4) y^{(x)} + \sqrt{x} y''' + \cos(x) = e^y$$

5. The P. D. E. is $\frac{\partial^2 z}{\partial x^2} + 5 \frac{\partial^2 z}{\partial x \partial y} + 6 \frac{\partial^2 z}{\partial y^2} = \frac{1}{y - 2x}$ then

a. C.F. = $\phi_1(y + 2x) + \phi_2(y + 3x)$

b. C.F. = $\phi_1(y - 2x) + \phi_2(y - 3x)$

c. P.I. = $x - (y - 3x) \log(y - 2x)$

d. P.I. = $x + (y - 3x) \log(y + 2x)$

Which of the statements given above is/are correct ?

(1) Only a and c

(2) Only a and d

(3) Only b and c

(4) Only b and d

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A

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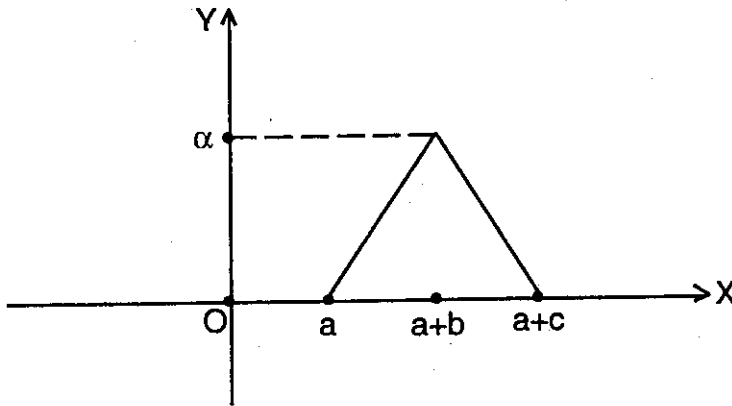
6. Given $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

- The characteristic equation is $|A - \lambda I| = 0$.
- The characteristic equation is $|A + \lambda I| = 0$.
- The characteristic roots (Eigen values) are 0, 3, 15.
- The characteristic roots (Eigen values) are 1, 5, 12.

Which of the statements given above is/are correct ?

- (1) Only a and d (2) Only b and c (3) Only b and d (4) Only a and c

7. Probability density function $P(x)$ of a random variable x as shown below, the value of α is



- (1) $\frac{1}{c}$ (2) $\frac{2}{b+c}$ (3) $\frac{1}{b+c}$ (4) $\frac{2}{c}$

8. There are 100 tickets numbered from 1 to 100. They are well shuffled and a ticket is drawn at random. The probability that the number on the ticket drawn is

- an even number is 0.5
- 5 or multiple of 5 is 0.2
- greater than 75 is 0.25
- is a square of integer 0.15

Which of the statements given above is/are correct ?

- (1) Only a and d (2) Only b
(3) Only a, b and c (4) Only c and d

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9. If $\frac{dy}{dx} = 1 + y^2$, where $y = 0$ when $x = 0$, then by using numerical technique $y(0.4) =$

- (1) 0.2356 (2) 0.4134
(3) 0.4228 (4) 0.4021

10. A car hire firm has two cars which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 1.5. Then the number of days in a year on which some demand is refused are

- (1) 70 days (2) 68 days
(3) 71 days (4) 72 days

11. A surface passing through the curves $z = 0, y^2 = 4ax$ and $z = 1, y^2 = -4ax$ and satisfying $x \frac{\partial^2 z}{\partial x^2} + 2 \frac{\partial z}{\partial x} = 0$ is

- (1) $4axy - xy^2 + y = 0$ (2) $8axz - 4ax + y^2 = 0$
(3) $axz + 4ay + y^2 = 0$ (4) None of these

12. The value of $\iint_S \text{curl } \vec{v} \cdot \vec{n} \, ds$, where $\vec{v} = \vec{i}y + \vec{j}z + \vec{k}x$, S is the surface of the paraboloid

$z = 1 - x^2 - y^2, z \geq 0$ and \vec{n} is the unit normal to S is

- (1) 3π (2) 6π
(3) 4π (4) π

13. The density function of a random variable X is $f(x) = \begin{cases} ce^{-2x} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$

then median is

- (1) 0.5066 (2) 0.2466
(3) 0.3466 (4) 0.2566

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14. If the function $f(x) = 2x^3 - 9kx^2 + 12k^2x + 1$, where $k > 0$ attains its maximum and minimum at p and q respectively such that $p^2 = q$, then $k =$

- (1) $\frac{1}{2}$ (2) 2
 (3) 1 (4) 3

15. The general term in the expansion of $\cosh z$ with the help of Taylor's series is

- (1) $\frac{z^{2n+1}}{(2n+1)!}$ (2) $\frac{z^{2n}}{(2n)!}$
 (3) $\frac{z^n}{n!}$ (4) None of these

16. Given the vectors $(1, 1, 0)$, $(3, 1, 3)$ and $(5, 3, 3)$

- a. The vectors are linearly independent
 b. The vectors are linearly dependent
 c. $(1, 1, 0) + (3, 1, 3) + (5, 3, 3) = 0$
 d. $(1, 1, 0) + (3, 1, 3) + (5, 3, 3) \neq 0$
 (1) Only b and d
 (2) Only b and c
 (3) Only a and c
 (4) None

17. a. $f(z) = 2xy + i(x^2 - y^2)$ is not analytic anywhere.

b. $f(z) = z |z|$ is analytic anywhere.

c. $f(z) = \bar{z}$ is not analytic anywhere.

d. $f(z) = |z|$ is continuous at every point.

Which of the statements given above is/are true ?

- (1) Only a is true (2) a and c are true
 (3) Only d is true (4) a, b and d are true

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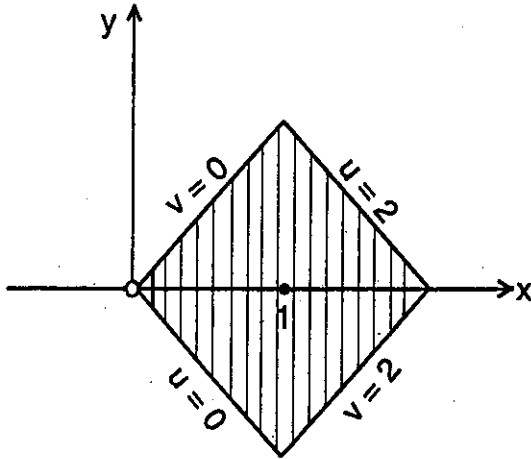
18. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, then \vec{r} is

- (1) Irrotational (2) Solenoidal
(3) Scalar (4) None of these

19. The value of integral $\int_0^1 \int_0^y xye^{-x^2} dy dx$ is

- (1) $4e$ (2) $\frac{1}{4e}$ (3) $\frac{1}{4}$ (4) e^2

20. The value of the double integral $\iint_R (x^2 + y^2) dx dy = \underline{\hspace{2cm}}$, where R is the square shown in figure.



- (1) $\frac{2}{5}$ (2) $\frac{3}{5}$ (3) $\frac{8}{3}$ (4) $\frac{5}{3}$

21. If $f(s) = \frac{1}{\sqrt{2s+3}}$ then $L^{-1}f(s)$ is

- (1) $\sqrt{\frac{t}{2\pi}} e^{-3/2t}$ (2) $\frac{t}{\sqrt{2\pi}} e^{-3/2t}$
(3) $\frac{1}{\sqrt{2\pi t}} e^{-3/2t}$ (4) None

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22. If A and B are symmetric matrices of the same order, then which one of the following is **not** correct ?

- (1) $A + B$ is a symmetric matrix
- (2) $AB - BA$ is a symmetric matrix
- (3) $AB + BA$ is a symmetric matrix
- (4) $A + A^T$ and $B + B^T$ are symmetric matrices

23. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$ then

- a. Eigen values of $A = 4, 1$
- b. Eigen values of $A = 4, -1$
- c. Eigen values of $A^T = 4, -1$
- d. Eigen values of $A^{-1} = \frac{1}{4}, -1$.

- (1) Only a
- (2) Only b and c
- (3) Only b, c and d
- (4) Only a and d

24. The Laurent series for $f(z) = \frac{z}{(z^2 - 1)(z^2 + 4)}$ if $|z| > 2$ is

- (1) $\sum_{n=1}^{\infty} \frac{(-1)^n}{z^{2n-1}} (1 - 2^n)$
- (2) $\frac{1}{3} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{z^{2n-1}} (1 + 4^n)$
- (3) $\frac{1}{5} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{z^{2n-1}} (1 + 4^{n-1})$
- (4) $\frac{1}{5} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{z^{2n-1}} (1 - 4^{n-1})$

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25. Let A be a 2×2 matrix which satisfy $A^2 - A = 0$, then

- (1) A is either $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ or $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$
- (2) There exists infinitely many such matrices
- (3) There exists no such matrix
- (4) A must be diagonal

26. A two port network is represented by ABCD parameters given by

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

If port 2 is terminated by R_L , then input impedance seen at port 1 is given by

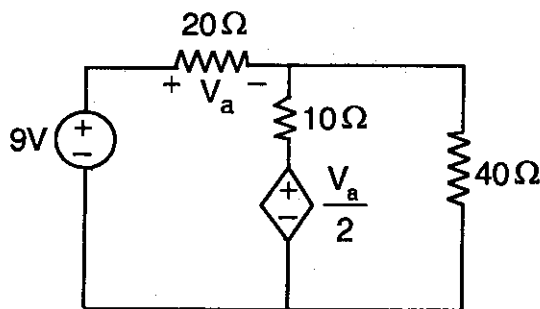
- (1) $\frac{A + BR_L}{C + DR_L}$ (2) $\frac{AR_L + C}{BR_L + D}$
- (3) $\frac{DR_L + A}{BR_L + C}$ (4) $\frac{B + AR_L}{D + CR_L}$

27. An iron ring of mean circumference 80 cm is made from round iron of area 8 cm^2 . It has a saw cut of 2 mm wide and is wound with 500 turns. The current required to produce a flux of 0.8 mWb across the air gap is

[Relative permeability of iron is 625 and leakage factor is 1.25]

- (1) 5.72 A (2) 6.03 A (3) 4.69 A (4) 1.39 A

28. The value of V_a in the circuit shown below is



- (1) 5 V (2) 10 V (3) 15 V (4) 55 V

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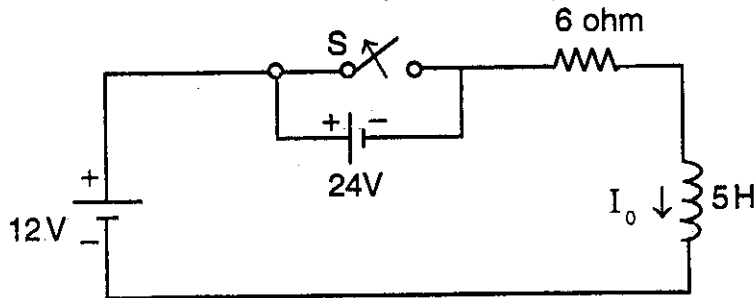
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29. The value of $\int_0^{\infty} e^{-st^2} dt$ is

- (1) $-\frac{1}{2}\sqrt{\frac{\pi}{s}}$ (2) $\sqrt{\frac{\pi}{s}}$ (3) $\frac{1}{2}\sqrt{\frac{\pi}{s}}$ (4) $\frac{\pi}{s}$

30. For a network shown below, the switch S is closed and a current 1A is flowing in the circuit. Now switch is opened. The current in the circuit will be



- (1) 3A (2) $3 - 3e^{-6/5t}$
 (3) $6 - 5e^{-6/5t}$ (4) $5e^{-6/5t}$

31. The magnetic field required to reduce the residual magnetization zero is called

- (1) Retentivity (2) Coercive force
 (3) Hysteresis (4) Saturation magnetization

32. The quality factor of a coil for the series circuit consisting of $R = 10\Omega$, $L = 0.1\text{ H}$ and $C = 10\mu\text{F}$ is

- (1) 10 (2) 20 (3) 100 (4) 30

33. The Fourier transform of two sided exponential function $f(t) = e^{-at}$ for $t \geq 0$
 $= e^{at}$ for $t \leq 0$

is given by

- (1) $\frac{2a}{a^2 + \omega^2}$ (2) $\frac{2\omega}{a^2 + \omega^2}$
 (3) $\frac{2(a + \omega)}{a^2 + \omega^2}$ (4) None of the above

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34. Consider a causal LTI system with frequency response $H(j\omega) = \frac{1}{j\omega + 3}$

For a particular input $x(t)$, this system is observed to produce the output

$$y(t) = e^{-3t}u(t) - e^{-4t}u(t).$$

Then $x(t)$ is

(1) $x(t) = e^{-4t}u(t)$

(2) $x(t) = e^{-3t}u(t)$

(3) $x(t) = -e^{-4t}u(t)$

(4) $x(t) = -e^{-3t}u(t)$

35. The time shifting property of Z-transform i.e. Z-transform of $x[n - n_0]$ is

(1) $Z^{-n_0}X[Z]$

(2) $Z^{n_0}X[Z]$

(3) $X(Z + Z_0)$

(4) $X[Z_0]$

36. A continuous time periodic signal $x(t)$ is real valued and has a fundamental period

$T = 8$, the non-zero Fourier series coefficients for $x(t)$ are $a_1 = a_{-1} = 2$, $a_3 = a_{-3}^* = 4j$

$x(t)$ in the form

$$x(t) = \sum_{K=0}^{\infty} A_K \cos(\omega_K t + \phi_K) \text{ is given by}$$

(1) $x(t) = 4 \cos\left(\frac{\pi}{4}t + \frac{\pi}{2}\right) + 8 \cos\left(\frac{3\pi}{4}t + \frac{\pi}{2}\right)$

(2) $x(t) = 2 \cos\left(\frac{\pi}{4}t\right) + 4 \cos\left(\frac{3\pi}{4}t\right)$

(3) $x(t) = 4 \cos\left(\frac{\pi}{4}t\right) + 8 \cos\left(\frac{3\pi}{4}t + \frac{\pi}{2}\right)$

(4) $x(t) = 2 \cos\left(\frac{\pi}{4}t + \frac{\pi}{2}\right) + 4 \cos\left(\frac{3\pi}{4}t + \frac{\pi}{2}\right)$

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37. If $x_1[n] = 2^n u[n]$ and $x_2[n] = u[n - 1]$ then, Z transform of $y[n] = x_1[n] * x_2[n]$ is

(1) $\frac{Z^2}{(Z-1)(Z-2)}$ ROC $|Z| > 2$

(2) $\frac{Z}{(Z-1)(Z-2)}$ ROC $|Z| > 2$

(3) $\frac{Z}{(Z+1)(Z+2)}$ ROC $|Z| < 2$

(4) $\frac{Z^2}{(Z+1)(Z+2)}$ ROC $|Z| < 2$

38. A discrete-time system is described by following i/p-o/p relationship

$$y(n) = \sum_{k=n-2}^{n+2} x(k)$$

This system is

- | | |
|--------------------------------|------------------------------|
| (1) Non-linear, Time-invariant | (2) Non-linear, Time-variant |
| (3) Linear, Time-invariant | (4) Linear, Time-variant |

39. For $F(s) = \frac{s+3}{(s+1)(s+2)}$, the inverse Laplace transform for $-2 < \text{Re}(s) < -1$ is

- | | |
|--------------------------|-----------------------------------|
| (1) $2e^{-t} - e^{-2t}$ | (2) $-2e^{-t}u(-t) - e^{-2t}u(t)$ |
| (3) $-2e^{-t} + e^{-2t}$ | (4) $2e^{-t}u(-t) + e^{-2t}u(t)$ |

40. A 500 kVA transformer with 0.01 pu resistance and 0.05 pu reactance connected in parallel with a 250 kVA transformer with 0.015 pu resistance and 0.04 pu reactance. The secondary voltage of each transformer is 400 V on no load. How they share a load of 750 kVA at power factor 0.8 lagging ?

- (1) 375 kVA at 0.8 lagging power factor each
- (2) 500 kVA at 0.8 PF lagging and 250 kVA at 0.8 PF lagging
- (3) 471 kVA at 0.762 lagging PF and 281 kVA at 0.856 PF lagging
- (4) 550 kVA at 0.7 lagging PF and 200 kVA at 0.85 lagging PF

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41. A 480 V, 60 Hz, three phase, four-pole induction motor has following parameters
 $R_1 = 0.3 \text{ ohm}$, $R'_2 = 0.2 \text{ ohm}$, $X_{\text{eq}} = 2.0 \text{ ohm}$

At full load, the motor speed is 1760 rpm. The developed full load torque and copper losses in motor are

- (1) 110.5 N-m and 0.9 KW
(2) 121.46 N-m and 1.27 KW
(3) 141.3 N-m and 1.5 KW
(4) 132.7 N-m and 1.4 KW

42. A 14.92 KW, 400 V, 400 rpm dc shunt motor draws a current of 40 A when running at full load. The moment of inertia of the rotating system is $7.5 \text{ kg} - \text{m}^2$. If the starting current is 1.2 time full load current, full load torque is

- (1) 356 N-m (2) 278 N-m (3) 465 N-m (4) 257 N-m

43. Three 1100/110 V transformers connected Δ/Δ supply a lighting load of 100 KW. One of these transformers is damaged and hence removed for repairs. The primary current flowing through each transformer when two transformers are in service, is

- (1) 303 A (2) 30.3 A (3) 52.5 A (4) 525 A

44. A 4 pole lap wound dc generator has a developed power of P watts and voltage of E volts. The adjacent brushes of the machine are removed as they are worn out. If the machine operates with the remaining brushes, the developed voltage and power that can be obtained from the machine are

- (1) $\frac{E}{2}$ and $\frac{P}{2}$ (2) E and P
(3) E and $\frac{P}{2}$ (4) E and $\frac{P}{4}$

45. Two transformers of identical voltages but different capacities are operating in parallel. For satisfactory load sharing

- (1) Impedances must be equal
(2) Per unit impedances must be equal
(3) Per unit impedances and $\frac{X}{R}$ ratio must be equal
(4) Impedances and $\frac{X}{R}$ ratio must be equal

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46. A four pole generator having wave wound armature winding has 51 slots, each slot containing 20 conductors. The voltage generated in the machine when driven at 1500 r.p.m., assuming the flux per pole to be 7 mWb is

- (1) 185.7 V (2) 178.5 V
(3) 270.3 V (4) 157.8 V

47. In a S.C. test on a circuit breaker, the following data was obtained on frequency transient.

- a) Time to reach peak restriking voltage = 55 μ sec.
b) Peak restriking voltage = 100 KV.

The average rate of rise of restriking voltage is given by

- (1) 0.91 KV/ μ sec (2) 0.455 KV/ μ sec
(3) 1.82 KV/ μ sec (4) None of the above

48. A 275 KV transmission line has the line constants $A = 0.85 \angle 5^\circ$, $B = 200 \angle 75^\circ$. If voltage profile at each end is to be maintained at 275 KV, what will be the receiving end power at unity power factor ?

- (1) 227.6 MW (2) 117.7 MW
(3) 109.9 MW (4) 258.9 MW

49. If p-q is a branch, a new bus is added to the partial network of 'n' bus system and the resultant impedance matrix is of dimensions

- (1) $(n + 1) \times (n + 1)$ (2) $(n + 1) \times (n - 1)$
(3) $(n - 1) \times (n + 1)$ (4) $n \times n$

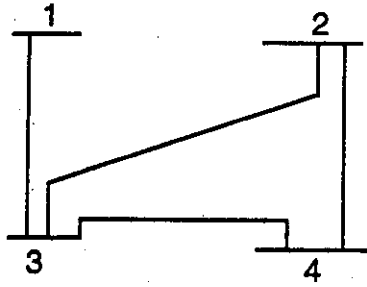
50. A 50 MVA, 11 KV, 3 phase alternator was subjected to different types of faults. The fault currents were : 3 phase fault 1870 A, line to line fault 2590 A and single line to ground fault 4130 A. The alternator neutral is solidly grounded. The three sequence reactances of alternator in pu are

- (1) $X_1 = 1.4$ pu, $X_2 = 0.35$ pu and $X_0 = 0.15$ pu
(2) $X_1 = 1.7$ pu, $X_2 = 0.35$ pu and $X_0 = 0.25$ pu
(3) $X_1 = 1.5$ pu, $X_2 = 0.5$ pu and $X_0 = 0.2$ pu
(4) $X_1 = 1.2$ pu, $X_2 = 0.4$ pu and $X_0 = 0.12$ pu

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51. A 4 bus system is shown below and line admittances are given in table :



| Line | $G \pm jB$ |
|------|-------------|
| 1-3 | $1 - j3$ |
| 2-3 | $0.67 - j2$ |
| 2-4 | $1 - j3$ |
| 3-4 | $2 - j6$ |

The Y_{bus} matrix is

$$Y_{bus} = \begin{bmatrix} 1-j3 & 0 & -1+j3 & 0 \\ 0 & 1.67-j5 & -0.67+j2 & -1+j3 \\ -1+j3 & -0.67+j2 & 3.67-j11 & -2+j6 \\ 0 & -1+j3 & -2+j6 & 3-j9 \end{bmatrix}$$

For Y_{bus} matrix,

- (1) Only diagonal elements are correct
- (2) Only off diagonal elements are correct
- (3) Both (1) and (2) are incorrect
- (4) Both (1) and (2) are correct

52. 3-ph alternator delivers 1.0 pu at 50 Hz to an infinite bus bar through transmission line. When subjected to fault, the maximum power reduced to 0.5 pu, whereas before the fault it was 2.00 pu and after clearance of fault 1.4 pu. Find critical clearing angle using equal area criteria.

- (1) 30 degree
- (2) 71.29 degree
- (3) 41.52 degree
- (4) 62.93 degree

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53. Which of the following statements are valid for HVDC transmission system ?

- a. No spin effect
- b. No stability problem
- c. There is spin effect
- d. There is stability problem.

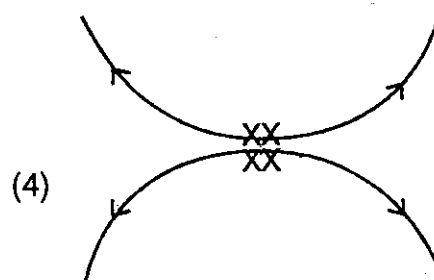
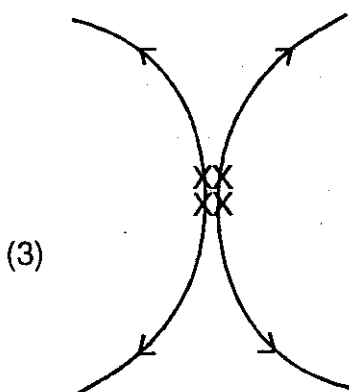
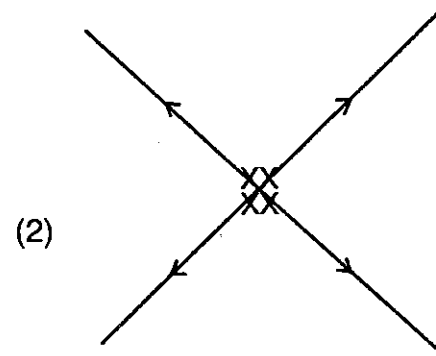
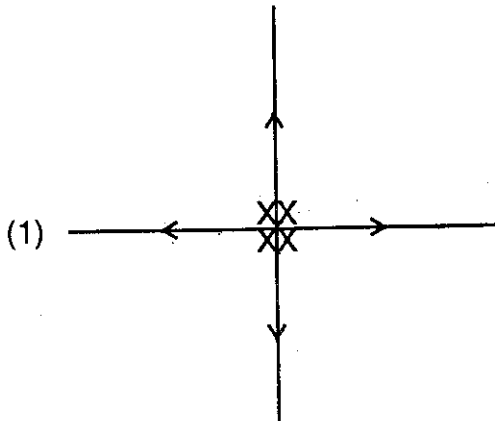
(1) a and d

(2) b and c

(3) a and b

(4) a

54. An open loop system is described by a transfer function $G(s) = \frac{K}{s^4}$. Root locus of the system is



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55. A unity feedback system has open loop TF $G(s) = \frac{K}{s(s+2)}$.

For closed loop system to have steady state unit ramp error of 0.1, value of 'K' required is

- (1) 40 (2) 20 (3) 10 (4) None of the above

56. The state transition matrix of the system $\dot{x} = Ax$ with initial condition $x(0)$ is

- (1) $(SI - A)^{-1}$ (2) $e^{At} x(0)$
(3) Laplace inverse of $[(SI - A)^{-1}]$ (4) Laplace inverse of $[(SI - A)^{-1} x(0)]$

57. For the system

$$\dot{X} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$Y = [1 \ 0] X$$

Which of the following statements are true ?

- (1) System is controllable and observable
(2) System is controllable and not observable
(3) System is not controllable and not observable
(4) System is not controllable but it is observable

58. For root locus of the system having $G(s)H(s) = \frac{K(s^2 + 4)}{(s+1)(s+3)}$ the break away point is

- (1) -2.26 (2) -1.7655
(3) -2.26, -1.7655 (4) None of the above

59. Which of the following properties are associated with state transition matrix ?

a. $\phi(-t) = \phi^{-1}(t)$

b. $\phi \begin{pmatrix} t_1 \\ t_2 \end{pmatrix} = \phi(t_1) \phi^{-1}(t_2)$

c. $\phi(t_1 - t_2) = \phi(-t_2) \phi(t_1)$.

- (1) a, b and c (2) a and b (3) b and c (4) a and c

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60. The nyquist plot of the system with open loop transfer function $G(s) = \frac{10}{s(s+2)(s+5)}$

will intersect the negative real axis at frequency $\omega =$

- (1) 2 rad/sec (2) 2.5 rad/sec
(3) 3.16 rad/sec (4) 5.2 rad/sec

61. The inductance of a moving iron instrument is given by

$$L = (10 + 5\theta - \theta^2) \mu\text{H}$$

where θ is deflection from zero position. The spring constant is 12×10^{-6} Nm/rad.

Estimate the deflection for a current of 5A.

- (1) 96.8° (2) 87.6°
(3) 107.8° (4) 90.8°

62. A Crompton's potentiometer consists of a resistance dial having 15 steps of 10Ω each and series connected slide wire of 10Ω divided into 100 divisions. If the working current of potentiometer is 10 mA and each division of slide wire can read accurately

upto $\frac{1}{5}$ th of its span. The range and resolution of potentiometer in volts is

- (1) 1.6 V, 0.2 mV (2) 1.6 V, 0.5 mV
(3) 1.5 V, 0.1 mV (4) 1.6 V, 0.1 mV

63. A CRT has an anode voltage of 2000 V and parallel deflecting plates 2 cm long and 5 mm apart. The screen is 30 cm from the centre of the plates. Find the input voltage required to deflect the beam through 3 cm. The input voltage is applied to the deflecting plates through amplifiers having an overall gain of 100.

- (1) 5 V (2) 1 V
(3) 0.1 V (4) 10 V

64. In respect to potential transformers, which of the following statements are true ?

- a. The variation of ratio error is almost linear with change in burden.
b. With increase in burden the phase angle becomes more negative.
c. The phase angle error is increased with increase in frequency.
d. The transformation ratio increases as power factor of secondary burden reduces.

- (1) Only a and b (2) a, c and d
(3) b, c and d (4) All are true

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65. An oscilloscope is operated in XY mode with X and Y inputs given by

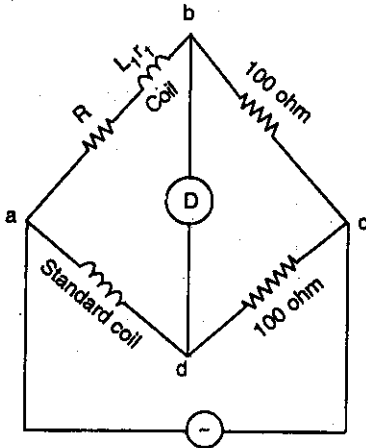
$$X = 10 \sin 314t$$

$$Y = 10 \sin \left(314t + \frac{\pi}{2} \right)$$

The trace generated is a

- (1) Straight line (2) Parabola
(3) Circle (4) Ellipse

66. A Maxwell's inductance bridge is shown below. The arm ab consists of coil having inductance of L_1 and resistance of r_1 in series with non-inductive resistance 'R'. Arm bc and dc consists of non-inductive resistance of 100 ohm each. Arm ad consists of standard variable inductor (coil) of resistance 32.7 ohm. Balance is obtained when standard coil inductance and resistance are 47.8 mH and 1.36 ohm respectively. What will be inductance and resistance of coil in arm ab ?



- (1) 47.8 mH, 32.7 ohm (2) 32.7 mH, 47.8 ohm
(3) 47.8 mH, 31.34 ohm (4) 47.8 mH, 47.8 ohm

67. A moving coil instrument whose resistance is 5Ω and working current (for full scale deflection) is 0.015 A, is to be used with a manganin shunt, to measure upto 100 A. If the instrument coil and leads are made up of copper, the error caused by 10°C rise in temperature is

[Temp. coefficients of copper and manganin are $0.0040 \text{ ohm/ohm/}^\circ\text{C}$ and $0.00015 \text{ ohm/ohm/}^\circ\text{C}$ resp.]

- (1) 4.3% (2) 3.7%
(3) 5.2% (4) 7%

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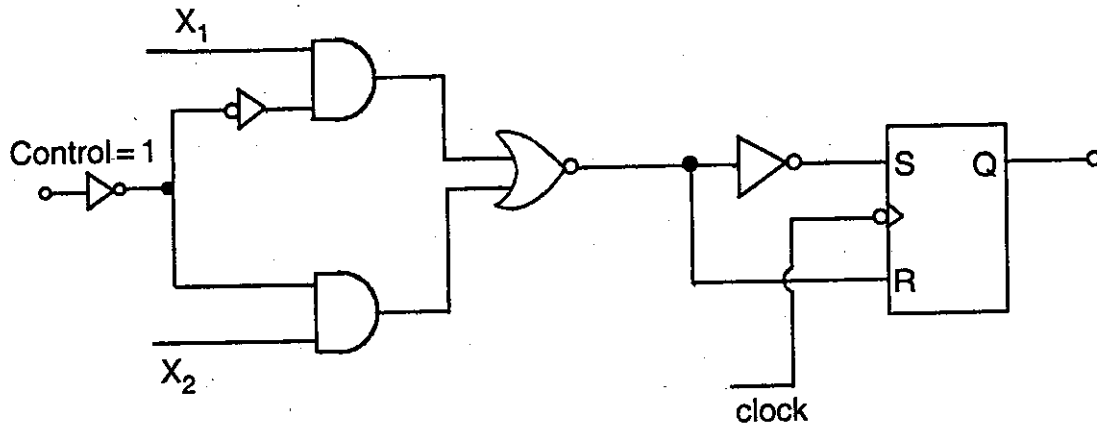
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68. A 8-bit microprocessor having 16 address lines have _____ memory.

- (1) 4 kb (2) 16 kb
(3) 64 kb (4) 256 kb

69. For the following logic diagram, if control i/p is '1', which of these actions takes place ?



- (1) Data bit at X_1 will be shifted into the flip-flop at next clock transition
(2) Data bit at X_2 will be shifted into the flip-flop at next clock transition
(3) Arbitrarily either X_1 or X_2 will be shifted into the flip-flop at next clock transition
(4) Flip-flop will retain the state at next clock transition

70. A differential amplifier has common mode rejection ratio 100. There are two sets of input signals

- i. $V_1 = +50 \mu V$; $V_2 = -50 \mu V$
ii. $V_1 = 1050 \mu V$; $V_2 = 950 \mu V$

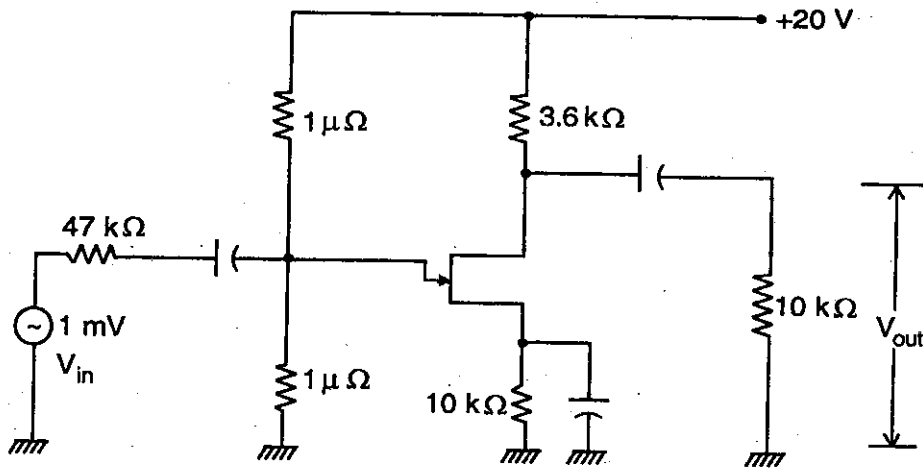
What is the percentage difference in output voltage obtained for the two sets of input signals ?

- (1) 0 (2) 10%
(3) 20% (4) 15%

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71. For the following CS JFET Amplifier, with $g_m = 5000 \mu\text{mho}$, if $V_{in} = 1 \text{ mV}$, what is the output voltage ?



- (1) 11.3 mV (2) 12.3 mV
(3) 13.3 mV (4) 14.3 mV
-
72. The 8085 assembly language instruction that stores the content of H and L registers into the memory locations 2050 H and 2051 H respectively, is
- (1) SPHL 2050 H (2) SPHL 2051 H
(3) SHLD 2050 H (4) LHLD 2050 H
-
73. An amplifier has open loop voltage gain $A_v = 90000$. If negative feedback of 10 dB is applied, the voltage feedback gain will be
- (1) 30250 (2) 28460
(3) 32430 (4) 35590
-
74. There are two inputs A, B and three feedback outputs x, y, z of an asynchronous sequential logic system.
If $xyzAB = 10011$ gives a stable state and input AB changes as $11 \rightarrow 10$, which of the following next state gives racing problem ?
- (1) 10110 (2) 00110 (3) 11010 (4) 00010

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75. A basic chopper has a resistive load of $R = 10 \Omega$ and input voltage of 220 V. When converter switch is ON, its voltage drop is 2V and chopping frequency is 1 KHz. For duty cycle of 50%, the average output voltage and rms output voltage is
- (1) 110 V, 156 V (2) 109 V, 154.15V
 (3) 110 V, 154.15 V (4) 109 V, 156 V

76. A step down chopper is operated in the continuous conduction mode in steady state with a constant duty ratio D . If V_o is the magnitude of the d.c. output voltage and if V_s is the magnitude of the d.c. input voltage, the ratio $\frac{V_o}{V_s}$ is given by
- (1) D
 (2) $1 - D$
 (3) $\frac{1}{1-D}$
 (4) $\frac{D}{1-D}$

77. A dc shunt motor has the armature resistance 0.04Ω and field winding resistance of 10Ω . Motor is coupled to an overhauling load with a torque of 400 N-m. Following magnetization curve was measured at 600 rpm.

| | | | | | | | | | | |
|--------------------------|-----|----|------|----|-------|-----|------|-----|------|-----|
| Field Current (A) | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 | 22.5 | 25 |
| Back Emf (V) | 25 | 50 | 73.5 | 90 | 102.5 | 110 | 116 | 121 | 125 | 129 |

Motor is braked by self-excited dynamic braking with a braking resistance of 1Ω . The speed at which the motor will hold the load is

- (1) 995 rpm
 (2) 1015 rpm
 (3) 1005 rpm
 (4) 670 rpm

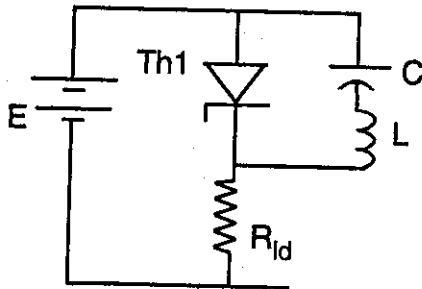
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78. A separately excited dc motor driven by converter drive has armature voltage varying between 0 to 500 V. If motor speed is 1800 rpm at maximum armature voltage and load torque is 300 N-m, the maximum power rating of the converter is
- (1) 28.26 KW (2) 14.13 KW
(3) 56.55 KW (4) None of the above

79. The parallel resonance thyristor turn-off circuit shown in the figure has the following data :

$E = 180 \text{ V}$, $R_{ld} = 580 \Omega$, pulse width $t_p = 1.3 \text{ ms}$, the load current is 0.7 times $I_{C(max)}$. The values of L and C are



- (1) 0.135 H and 0.817 μF
(2) 0.103 H and 0.718 μF
(3) 0.139 H and 0.788 μF
(4) None of the above
80. In respect of insulated gate bipolar transistors, which of the following statements are valid ?
- a. on state voltage drop is small
b. current sharing in parallel IGBTs is better than Power MOSFET
c. It is preferred in applications require high blocking voltages and lower operating frequencies
d. It has parasitic latch ups
- (1) Only a and c
(2) Only b and d
(3) All are valid
(4) a, b and c

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सूचना - (पृष्ठ 1 वरून पुढे....)

- (9) प्रश्नपुस्तिकेमध्ये विहित केलेल्या विशिष्ट जागीच कच्चे काम (रफ वर्क) करावे. प्रश्नपुस्तिकेव्यतिरिक्त उत्तरपत्रिकेवर वा इतर कागदावर कच्चे काम केल्यास ते कॉपी करण्याच्या उद्देशाने केले आहे, असे मानले जाईल व त्यानुसार उमेदवारावर शासनाने जारी केलेल्या “परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचे अधिनियम-82” यातील तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल.
- (10) सदर प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपल्यानंतर उमेदवाराला ही प्रश्नपुस्तिका स्वतः बरोबर परीक्षाकक्षाबाहेर घेऊन जाण्यास परवानगी आहे. मात्र परीक्षाकक्षाबाहेर जाण्यापूर्वी उमेदवाराने आपल्या उत्तरपत्रिकेचा भाग - 1 समवेक्षकाकडे न विसरता परत करणे आवश्यक आहे.

नमुना प्रश्न

Pick out the correct word to fill in the blank :

Q.No. 201. I congratulate you _____ your grand success.

- | | |
|---------|-----------|
| (1) for | (2) at |
| (3) on | (4) about |

ह्या प्रश्नाचे योग्य उत्तर “(3) on” असे आहे. त्यामुळे या प्रश्नाचे उत्तर “(3)” होईल. यास्तव खालीलप्रमाणे प्र. क्र. 201 समोरील उत्तर-क्रमांक “③” हे वर्तुळ पूर्णपणे छायांकित करून दाखविणे आवश्यक आहे.

प्र.क्र. 201. ① ② ● ④

अशा पद्धतीने प्रस्तुत प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाचा तुमचा उत्तरक्रमांक हा तुम्हाला स्वतंत्ररीत्या पुरविलेल्या उत्तरपत्रिकेवरील त्या त्या प्रश्नक्रमांकासमोरील संबंधित वर्तुळ पूर्णपणे छायांकित करून दाखवावा. ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.

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