Sr.No. 25216

E

SUBJECT CODE BOOKLET CODE

2015 (I)
ENGINEERING SCIENCES
TEST BOOKLET

6 A

Time : 3:00 Hours

Maximum Marks: 200

INSTRUCTIONS

1. This Test Booklet contains one hundred and fifteen (20 Part'A'+25 Part 'B' + 70 Part 'C') Multiple Choice Questions (MCQs). You are required to answer a maximum of 15, 20 and 20 questions from part 'A' 'B' and 'C' respectively. If more than required number of questions are answered, only first 15, 20, 20 questions in Parts 'A' 'B' and 'C' respectively, will be taken up for evaluation.
2. **OMR** answer sheet has been provided separately. Before you start filling up your particulars, please ensure that the booklet contains requisite number of pages and that these are not torn or mutilated. If it is so, you may request the Invigilator to change the booklet of the same code. Likewise, check the OMR answer sheet also. Sheets for rough work have been appended to the test booklet.
3. Write your Roll No., Name and Serial Number of this Test Booklet on the OMR answer sheet in the space provided. Also put your signatures in the space earmarked.
4. **You must darken the appropriate circles with a black ball pen related to Roll Number, Subject Code, Booklet Code and Centre Code on the OMR answer sheet. It is the sole responsibility of the candidate to meticulously follow the instructions given on the Answer Sheet, failing which, the computer shall not be able to decipher the correct details which may ultimately result in loss, including rejection of the OMR answer sheet.**
5. Each question in Part 'A' carries **2** marks, Part 'B' **3.5** marks and Part 'C' **5** marks respectively. There will be negative marking @ 25% for each wrong answer.
6. Below each question in Part 'A', 'B' and 'C' four alternatives or responses are given. Only one of these alternatives is the "correct" option to the question. You have to find, for each question, the correct or the best answer.
7. Candidates found copying or resorting to any unfair means are liable to be disqualified from this and future examinations.
8. Candidate should not write anything anywhere except on answer sheet or sheets for rough work.
9. Use of scientific calculator without data connectivity is permitted.
10. **After the test is over, at the perforation point, tear the OMR answer sheet, hand over the original OMR answer sheet to the invigilator and retain the carbonless copy for your record.**
11. Candidates who sit for the entire duration of the exam will only be permitted to carry their Test booklet.

Roll No.....

Name .....

OMR Answer Sheet No.....

I have verified all the information filled in by the candidate.

.....
Signature of the Invigilator

ROUGH WORK

PART 'A'

1. Each of the following pairs of words hides a number, based on which you can arrange them in ascending order. Pick the correct answer:
   I. Cloth reel
   J. Silent wonder
   K. Good tone
   L. Bronze rod

   1. L, K, J, I
   2. I, J, K, L
   3. K, L, J, I
   4. K, J, I, L

2. Which of the following values is same as $2^{2^{2^2}}$?
   1. 2^6
   2. 2^8
   3. 2^{16}
   4. 2^{222}

3. A 12 m × 4 m rectangular roof is resting on four 4 m tall thin poles. Sunlight falls on the roof at an angle of 45° from the east, creating a shadow on the ground. What will be the area of the shadow?
   1. 24 m^2
   2. 36 m^2
   3. 48 m^2
   4. 60 m^2

4. If

$$\begin{array}{r} 2\,a \\ \times\ b\,2 \\ \hline c\,6 \\ 8\,4 \\ \hline 8\,d\,6 \end{array}$$

   Here a, b, c and d are digits. Then a + b =
   1. 4
   2. 9
   3. 11
   4. 16

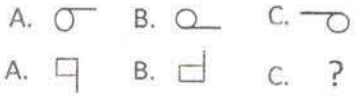
5. The maximum number of points formed by intersection of all pairs of diagonals of convex octagon is
   1. 70
   2. 400
   3. 120
   4. 190

6. Find the height of a box of base area 24 cm × 48 cm, in which the longest stick that can be kept is 56 cm long.
   1. 8 cm
   2. 32 cm
   3. 37.5 cm
   4. 16 cm

7. The product of the perimeter of a triangle, the radius of its in-circle, and a number gives the area of the triangle. The number is
   1. 1/4
   2. 1/3
   3. 1/2
   4. 1

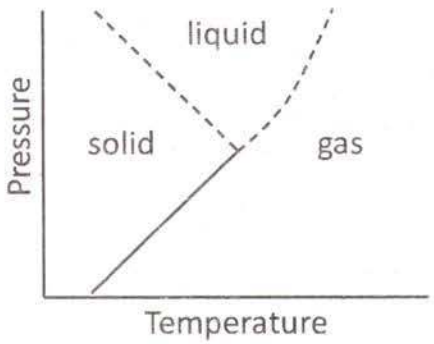
8. An infinite row of boxes is arranged. Each box has half the volume of the previous box. If the largest box has a volume of 20 cc, what is the total volume of all the boxes'?
   1. Infinite
   2. 400 cc
   3. 40 cc
   4. 80 cc

9. Find the missing element based on the given pattern



   1. 
   2.
   3. 
   4.

10. By reading the accompanying graph, determine the INCORRECT statement out of the following.



1. Melting point increases with pressure
2. Melting point decreases with pressure
3. Boiling point increases with pressure
4. Solid, liquid and gas can co-exist at the same pressure and temperature

11. If you change only one observation from a set of 10 observations, which of the following will definitely change?

1. Mean
2. Median
3. Mode
4. Standard deviation

12. A man starts his journey at 0100 Hrs local time to reach another country at 0900 Hrs local time on the same date. He starts a return journey on the same night at 2100 Hrs local time to his original place, taking the same time to travel back. If the time zone of his country of visit lags by 10 hours, the duration for which the man was away from his place is

1. 48 hours
2. 20 hours
3. 25 hours
4. 36 hours

13. Let r be a positive number satisfying

$$r^{(1/1234)} + r^{(-1/1234)} = 2$$

Then

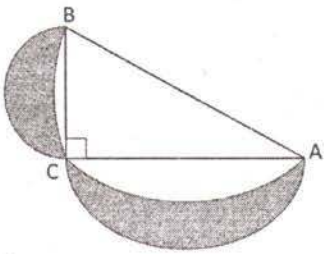
$$r^{4321} + r^{-4321} = ?$$

1. 2
2. $2^{(4321/1234)}$
3. 2^{3087}
4. 2^{1234}

14. A float is drifting in a river, 10 m downstream of a boat that can be rowed at a speed of 10 m/ minute in still water. If the boat is rowed downstream, the time taken to catch up with the float

1. will be 1 minute
2. will be more than 1 min
3. will be less than 1 min
4. can be determined only if the speed of the river is known

15. ABC is a right angled triangle inscribed in a semicircle. Smaller semicircles are drawn on sides BC and AC. If the area of the triangle is a, what is the total area of the shaded lumes?



1. a
2. πa
3. a/π
4. $a/2\pi$

16. An ant can lift another ant of its size whereas an elephant cannot lift another elephant of its size, because

1. ant muscle fibres are stronger than elephant muscle fibres.
2. ant has proportionately thicker legs than elephant
3. strength scales as the square of the size while weight scales as cube of the size
4. ants work cooperatively, whereas elephants work as individuals

17. Consider a series of letters placed in the following way:

U__G__C__C__S__I__R

Each letter moves one step to its right and the extreme right letter takes the first position, completing one operation. After which of the following numbers of operations do the Cs not sit side by side?

1. 3
2. 10
3. 19
4. 25

18. An inclined plane rests against a horizontal cylinder of radius R. If the plane makes an angle of 30° with the ground, the point of contact of the plane with the cylinder is at a height of

1. 1.500 R
2. 1.866 R
3. 1.414 R
4. 1.000 R

19. What is the maximum number of parallel, non-overlapping cricket pitches (length 24 m, width 3 m) that can be laid in a field of diameter 140 m, if the boundary is required to be at least 60 m from the centre of any pitch?

1. 6
2. 7
3. 12
4. 4

20. In a fast moving car with open windows, the driver feels a continuous incoming breeze. The pressure inside the car, however, does not keep increasing because,

1. air coming in from the front window goes out from the rear.
2. air comes in as well as goes out through every window but the driver only feels the incoming one.
3. no air actually comes in and the feeling of breeze is an illusion.
4. cool air reduces the temperature therefore the pressure does not increase.

PART 'B'

MATHEMATIC

21. Let $A = \begin{pmatrix} 1 & 2 & -3 & 4 \\ 2 & 5 & -2 & 1 \\ 5 & 12 & -7 & 6 \end{pmatrix}$. Consider the system of equations $A \begin{pmatrix} x \\ y \\ z \\ t \end{pmatrix} = \begin{pmatrix} 2 \\ 1 \\ 7 \end{pmatrix}$.

Then the rank of A is

1. 3 and the above system has a solution
2. 3 and the above system has NO solution
3. 2 and the above system has a solution
4. 2 and the above system has NO solution

22. Let $A = \begin{pmatrix} 3 & 0 & 0 \\ 0 & 2 & -5 \\ 0 & \alpha & -2 \end{pmatrix}$ for some $\alpha \in \mathbb{R}$. Suppose there exists a 3×3 matrix P such that $P^{-1}AP = \begin{pmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & -3 \end{pmatrix}$. Then the value of α is

1. -1
2. 0
3. 1
4. 3

23. Let $a_1 = 1$ and $a_{n+1} = a_n + 3$ for $n \geq$ 1. Then the series

$\sum_{n=1}^{\infty} \frac{1}{(a_n+3)(a_{n+1}+3)}$ converges to

1. 3
2. $\frac{1}{3}$
3. 12
4. $\frac{1}{12}$

24. Consider the following improper integrals

$I_1 = \int_1^\infty \frac{e^t}{t^2} dt$ and $I_2 = \int_1^\infty \frac{e^{-t}}{t}\, dt$.

Then

1. I_1 converges but NOT I_2
2. I_2 converges but NOT I_1
3. both I_1 and I_2 converge
4. neither I_1 nor I_2 converges

25. Let $f(x,y) = y^2 + 2x^2y$ for all $(x,y) \in \mathbb{R}^2$. Then f has a local minimum

1. at $(0,0)$ but NOT at $(1,0)$
2. at $(1,0)$ but NOT at $(0,0)$
3. at both $(0,0)$ and $(1,0)$
4. neither at $(0,0)$ nor at $(1,0)$

26. Let C be the boundary of the region $\{(x,y) \in \mathbb{R}^2 : (x-1)^2 + y^2 \leq 1\}$. Then the value of the line integral

$$\oint_C (3x^2y + \sin^2 x)dx + (x^3 + 2x + \cos^2 y)dy$$

along the counter-clockwise direction is

1. π
2. 2π
3. 3π
4. 4π

27. Let Γ be a circle centred at zero on $\mathbb{C}\backslash\{0\}$. The value of $\int_\Gamma \left(\sin\frac{1}{z} + \sin^2\frac{1}{z}\right) dz$ is equal to

1. 0
2. πi
3. $2\pi i$
4. $4\pi i$

28. Consider the initial value problem $y' + \left(\frac{y}{x}\right)^2 - \frac{y}{x} = 0$ on $[1,\infty)$ with the initial condition $y(1) = \frac{1}{\ln 2}$. If x_0 satisfies $y(x_0) = x_0$ then x_0 is

1. e
2. $\frac{e}{2}$
3. $e-1$
4. $e+1$

29. Consider the initial value problem $y'' + 4y' + 4y = 0$ with the initial conditions $y(0) = 1$ and $y'(0) = -1$. The value of $\frac{y(\ln 2)}{1+\ln 2}$ is

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

30. A fair coin is flipped five times. The probability of occurrence of 2 or 3 heads is

1. $\frac{3}{8}$
2. $\frac{1}{2}$
3. $\frac{1}{4}$
4. $\frac{5}{8}$

ENGINEERING APTITUDE

31. A Carnot engine operates between two reservoirs at 500°C and 100°C, respectively. It rejects 250 kJ/cycle. The work developed/cycle is

1. 268 kJ
2. 518 kJ
3. 1000 kJ
4. 1250 kJ

32. Following statements are made for an ideal Otto cycle

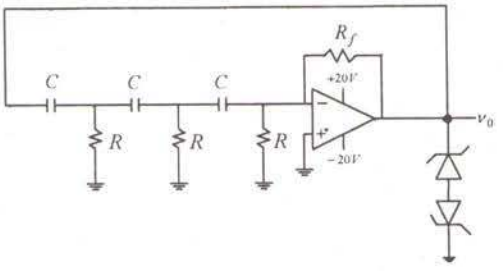
(a) All the processes are internally reversible.
(b) Efficiency increases with the maximum temperature.
(c) Efficiency does not depend on the type of gas executing the cycle
(d) The gas temperature becomes maximum after compression.

1. (a) and (b) are true
2. (a) and (c) are true
3. (a) and (d) are true
4. (c) and (d) are true

33. Water is sprayed in air with a relative humidity of 50% in an adiabatic constant pressure process. Indicate the correct statement.
    1. Dry bulb temperature decreases but wet bulb temperature increases.
    2. Dry bulb temperature decreases but wet bulb temperature remains constant.
    3. Dry bulb temperature decreases but relative humidity remains constant.
    4. Both dry bulb temperature and dew point temperature decreases.

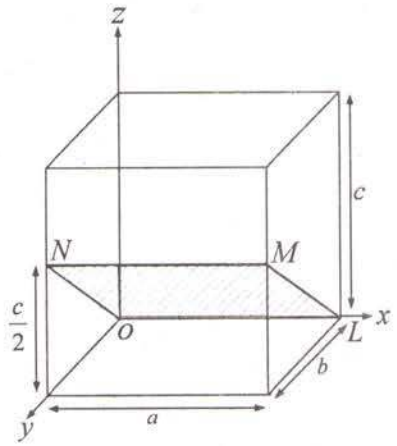
34. The energy gap of GaAs is E_g = 1.42 eV and experimental values for the effective densities of states at the bottom of conduction band (E_C) and the top of valance band (E_V), at room temperature, respectively, are $N_C = 4.7 \times 10^{17} cm^{-3}$ and $N_V = 4.7 \times 10^{18} cm^{-3}$. The thermal voltage at room temperature is $V_T = \frac{KT}{q} = 26\ mV$. Concerning the position of Fermi level (E_F) of intrinsic GaAs at room temperature, which one of the following statements is true?
    1. $E_F - E_V = 0.710\ eV$
    2. $E_C - E_F = 0.675\ eV$
    3. $E_F - E_V = 0.675\ eV$
    4. $E_C - E_F = 0.745\ eV$

35. For the oscillator circuit shown, the OPAMP supply voltage is $\pm 20\ V, R = 400\ k\Omega$ and C = 100 pF. The zener diode has a breakdown voltage of 6.8 V and a forward voltage drop of 0.7 V. The frequency and amplitude of output voltage (v_O) are



    1. 1.625 kHz and 7.5 V
    2. 3.980 kHz and 13.6 V
    3. 10.210 kHz and 7.5 V
    4. 25 kHz and 13.6 V

36. The Miller indices of the plane OLMN shown in the adjacent figure is



    1. (0 1 2)
    2. (0 1 $\bar{2}$)
    3. (0 $\bar{1}$ 2)
    4. (0 2 $\bar{1}$)

37. Match the following

(a)	Stress – 'inverse square root of crack length'	(i)	Basquin equation
(b)	S-N curve	(ii)	Paris equation
(c)	Crack growth rate curve	(iii)	Griffith equation
(d)	Stress – 'inverse square root of grain size'	(iv)	Hall-petch-equation

    1. (a) – (i), (b) – (ii), (c) – (iii), (d) – (iv)
    2. (b) – (i), (c) – (ii), (d) – (iv), (a) – (iii)
    3. (c) – (i), (d) – (ii), (a) – (iii), (b) – (iv)
    4. (d) – (iv), (a) – (i), (b) – (iii), (c) – (ii)

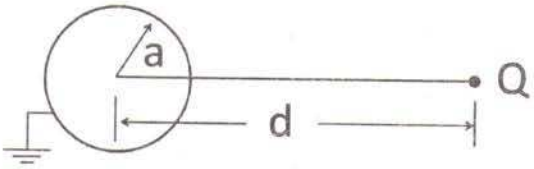
38. In a linear and isotropic medium, the current density J is proportional to $2\hat{\imath} - 3\hat{\jmath} + \hat{k}$. The magnetic flux density B is given by $(x + C_1 z)\hat{\imath} + (x - 3z)\hat{\jmath} + (x + C_2 y + C_3 z)\hat{k}$, where C_1, C_2, C_3 are constants. Assuming no time varying electric fields, the value of these constants are

1. $C_1 = 1 \quad C_2 = 1 \quad C_3 = -0$
2. $C_1 = -2 \quad C_2 = -1 \quad C_3 = -1$
3. $C_1 = 4 \quad C_2 = 5 \quad C_3 = -1$
4. $C_1 = 1 \quad C_2 = 1 \quad C_3 = -1$

39. The standing wave ratio on a lossless 50 Ω transmission line terminated in an unknown load impedance is found to be 4. The distance between successive voltage minima is 25 cm and the first minima is located 10 cm from the load. The load impedance is

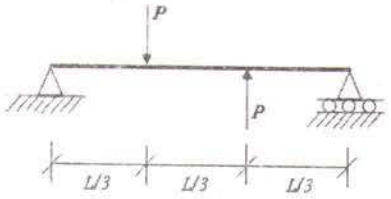
1. 13.74 + j 15.15
2. 18.48 + j 33.01
3. 32.29 + j 57.66
4. 82.13 + j 90.58

40. A positive point charge Q is located at a distance d from the centre of a grounded conducting sphere of radius a as shown in the figure. The force on Q caused by the charges induced on the sphere is



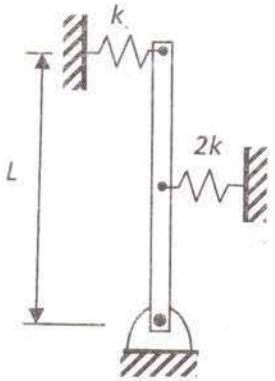
1. *0*
2. $\frac{Q^2}{4\pi\epsilon_0}\frac{d}{(d^2-a^2)^{3/2}}$ towards the sphere
3. $\frac{Q^2}{4\pi\epsilon_0}\frac{ad}{(d^2-a^2)^2}$ towards the sphere
4. $\frac{Q^2}{4\pi\epsilon_0}\frac{ad^2}{(d^2-a^2)^2}$ towards the sphere

41. A simply supported beam is loaded as shown in the figure. Find the magnitude of bending moment (BM) and shear force (SF) at the mid-span.



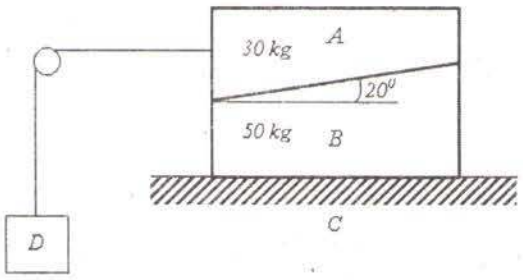
1. $\text{BM} = \frac{PL}{12}\,;\, SF = \frac{P}{2}$
2. $\text{BM} = \frac{PL}{12}\,;\, SF = \frac{2P}{3}$
3. $\text{BM} = 0\,;\, SF = \frac{2P}{3}$
4. $\text{BM} = 0\,;\, SF = \frac{P}{3}$

42. For the system shown, what is the natural frequency for small amplitudes of oscillations? The rod is uniform and has mass m.



1. $\sqrt{\frac{9k}{2m} - \frac{3g}{2L}}$
2. $\sqrt{\frac{9k}{2m} + \frac{3g}{2L}}$
3. $\sqrt{\frac{3g}{2L} - \frac{9k}{2m}}$
4. $2\sqrt{\frac{9k}{2m} - \frac{3g}{2L}}$

43. Considering the case of both the blocks shown slide together on the surface C, find the smallest value of the weight D that will cause the loss of static friction. Assume the coefficient of static friction between block A and B is 0.6 and the block B and the surface C as 0.4. Assume that block B does not slide over surface C..



1. 26.2kg
2. 7.2kg
3. 5.8kg
4. 18kg

44. A turbulent flow is highly random and chaotic. Description for a typical turbulent velocity signal refers to one of the following true statements.

1. The turbulent velocity signal is deterministic and repeatable.
2. The mean and variance of the turbulent velocity signal is deterministic and is repeatable.
3. The turbulent flow is purely sinusoidal.
4. The turbulent velocity signal is statistically non-deterministic.

45. Consider the velocity field $\vec{V} = Ax\hat{\imath} - Ay\hat{\jmath}$, where A = 0.1 s^{-1} and the coordinates are measured in meters. A square element is marked in the fluid at initial time. With the evolution of time, the square element will become

1. Rectangle with x-dimension greater than y-dimension.
2. Parallelogram with non-orthogonal edges.
3. Rectangle with x-dimension less than y-dimension.
4. Rectangular hyperbola.

PART 'C'

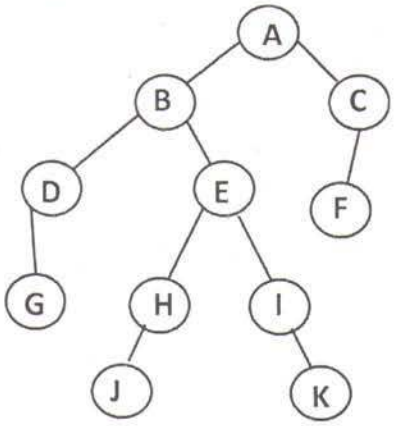
COMPUTER SCIENCE

46. What is printed by the following program?

```
#include <stdio. h>
void check( );
int a = 5 ;
int main( )
        { a+ = 4;
          check( ) ;
          return 0 ;
        }
void check( )
        { + + a ;
          printf ( " a = % d ", a) ;
        }
```

1. a = 5
2. a = 9
3. a = 6
4. a = 10

47. A node of a rooted binary tree is said to have preorder number i, if the node occurs in the i^{th} position in the preorder traversal sequence. The notions of postorder number and inorder number are defined in a similar manner. We use the notations PRE(X), POST(X) and IN (X) to denote the preorder number, postorder number and Inorder number of a node X respectively. Consider the following tree:



For the tree given above, which of the following is TRUE.

1. (PRE (A), POST (H), IN (F)) = (1, 4, 9)
2. (PRE (B), POST (I), IN (D)) = (2, 6, 1)
3. (PRE (C), POST (D), IN (E)) = (10, 3, 6)
4. (PRE (J), POST (K), IN (G)) = (7, 5, 3)

48. Assume that the symbols $\Lambda, V, \neg,$ and $\rightarrow$ denote logical AND, OR, NOT and implication respectively. The logical expression $\neg(\ (p\ V\ q) \rightarrow r)$ *is logically equivalent to*

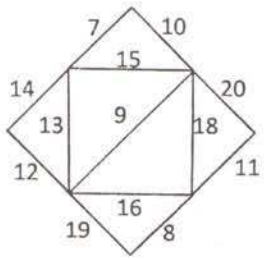
1. $(q\ \Lambda\ r) \rightarrow \neg r$
2. $(p\ \Lambda\ q)\ \Lambda\ \neg r$
3. $(p\ V\ q)\ \Lambda\ \neg r$
4. $(q\ V\ p) \rightarrow \neg r$

49. A question paper consists of 10 questions with 5 questions in Part A and 5 questions in Part B. A student must answer 7 out of these 10 questions with at least 3 selected from Part A. The number of ways in which the student can complete the examination is:

1. 70
2. $\binom{10}{7} = 120$
3. 105
4. 110

50. The cost of minimum cost spanning tree of the following graph is:

1. 72
2. 73
3. 74
4. 75



51. The number of digits in the binary equivalent of $(10000000000)_3$ is:

1. $\lfloor 9 \log_2(3) \rfloor + 1$
2. $\lfloor 10 \log_2(3) \rfloor + 1$
3. $\lceil 10 \log_2(3) \rceil + 1$
4. $\lfloor 9 \log_3(2) \rfloor + 1$

52. SDRAM cells are arranged in 8 K rows and it takes 4 clock cycles to read each row. At a clock rate of 1.33 GHz, the refresh overhead in each 64-ms time interval is:

1. 0.038
2. 0.0038
3. 0.00038
4. 0.000038

53. The following is a set of processes that arrive at time 0 (with the given CPU burst time):
P_1 : 5 ms, P_2 : 9 ms, P_3 : 7 ms. Assume that the order in which these processes are processed is (P_1, P_2, P_3).
The average waiting time of the processes if Round – Robin scheduling mechanism is used with a time quantum of 4 ms, assuming the order of processes to be (P_1, P_2, P_3) is:

1. 11 ms
2. 10 ms
3. 21 ms
4. 21/3 ms

54. Let R = (A,B,C) & let r_1 & r_2 both be relations on schema R.
The SQL expression
Select *
From r1
Where (A,B,C) in (select * from r2)
Is equivalent to:

1. $r_1 - r_2$
2. $r_1 \cap r_2$
3. $r_1 \cup r_2$
4. $r_2 - r_1$

55. The cyclomatic complexity for a connected flow graph, with 11 flow graph edges and 8 flow graph nodes is:

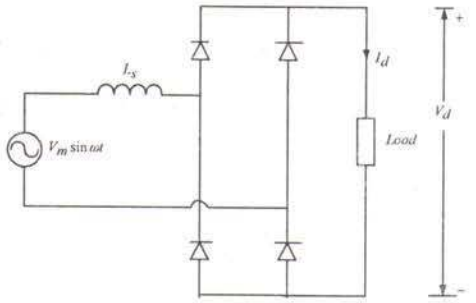
1. 3
2. 5
3. 88
4. 19

ELECTRICAL SCIENCE

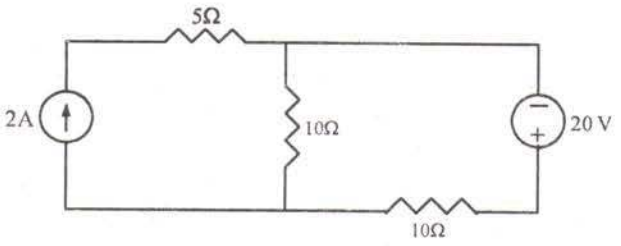
56. Consider the bridge rectifier with source inductance L_s as shown in figure. Assuming that the load current I_d is smooth and ripple free, the dc output voltage (V_d) of the rectifier is

1. $\frac{V_m}{\pi}\left(1-\frac{\omega L_s}{V_m}I_d\right)$ 2. $\frac{2V_m}{\pi}\left(1-\frac{\omega L_s}{V_m}I_d\right)$

3. $\frac{V_m}{\pi}\left(1-\frac{\omega L_s}{2V_m}I_d\right)$ 4. $\frac{2V_m}{\pi}\left(1-\frac{\omega L_s}{2V_m}I_d\right)$

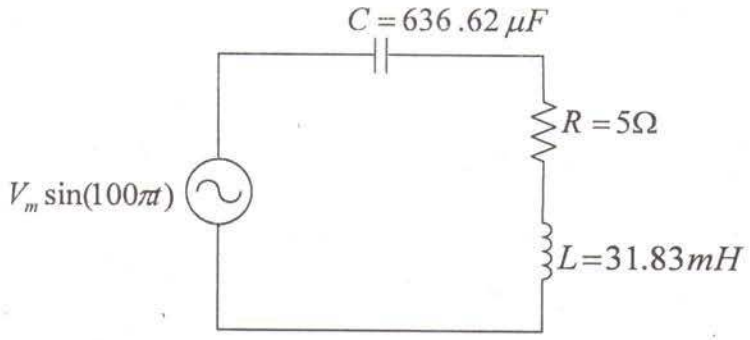


57. The current and voltage sources shown in figure are ideal. The power delivered by the 2A current source is



1. 0 W 2. 10 W 3. 20 W 4. 40 W

58. In the figure, the voltage across the inductor is 25 V. Then peak value (Vm) of supply voltage is



1. 8.84V 2. 12.5V 3. 17.68V 4. 25V

59. Consider a unity negative feedback system having open loop transfer function $G(s)=\frac{K(s^2-2s+2)}{(s+1)(s+2)(s+3)}$ where $K > 0$. The root locus for the system intersects the imaginary axis at the points

1. j1.0, -j1.0
2. j1.2, -j1.2
3. j2.2, -j2.2
4. j4.6, -j4.6

60. Consider a unity negative feedback system having open loop transfer function $G(s)=\frac{8}{s(s+1)(2s+1)}$. The number of clockwise encirclements of -1+j0 point by the Nyquist plot of the above system is

1. 0
2. 1
3. 2
4. 3

61. A 3 phase 11 kV, 50 Hz generator feeds a load of 50 MW at unity power factor through a short transmission line of reactance 0.2 pu with respect to base of 100 MVA, 11 kV. Neglecting line resistance, the amount of reactive power in MVAR injected at the load end to keep the load end voltage at 11 kV is

1. -2.506
2. 0
3. 2.506
4. 25.06

62. A 10 MVA, 6.6 kV generator has following sequence reactances $X_1= X_2= 0.2$ pu and $X_0= 0.05$ pu. A L-L fault occurs between phase b and c of the generator running at no load and at rated voltage. The voltage in the healthy phase in kV is

1. 0
2. 1.904
3. 3.81
4. 6.6

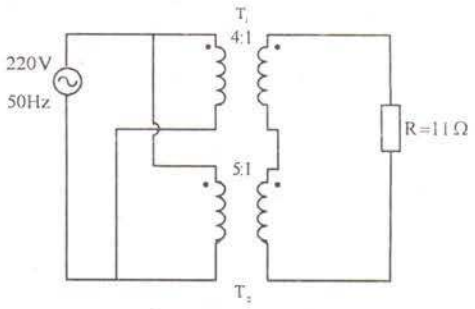
63. A 3 phase transmission line has flat horizontal spacing of 2 m between adjacent conductors. The radius of each conductor is 0.5 cm. At certain instant, the charges on the center conductor and on one of the outside conductors are identical and the voltage drop between these identically charged conductors is 600 V. Neglecting the effect of ground, the value of the identical charge in μC/km at the instant specified is

1. 11.34
2. 13.90
3. 24.08
4. 30.10

64. A 220 V DC shunt motor has an armature circuit resistance of 0.2 Ω and field resistance of 110 Ω. At no load, the motor takes 5 A and runs at 1500 rpm. The rotational losses at no load and full load are the same. If the motor draws 52 A at rated voltage and rated load, neglecting armature reaction, approximate value of the motor speed in rpm is

1. 1400
2. 1436
3. 1470
4. 1500

65. A load of 11Ω is connected to two 1- phase ideal transformers T_1 and T_2 as shown in figure. The input power to the primary is



1. 54 W
2. 891 W
3. 1100 W
4. 1500 W

MATERIALS SCIENCE

66. Silicon carbide has zinc blende structure. The atomic radii for silicon and carbon are 0.118 and 0.071 nm, respectively. The atomic weights of Si and C are 28.09 and 12.01, respectively. The atomic packing factor and the density of SiC are:

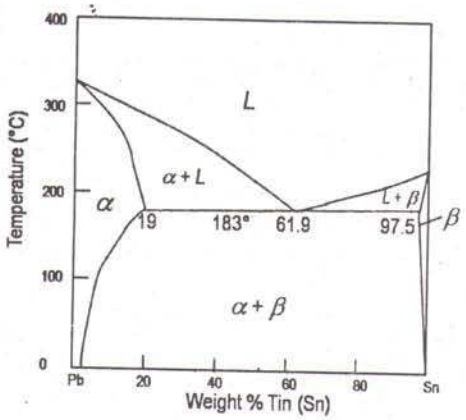
1. 0.40 and 3.21 g/cm^3
2. 0.62 and 2.24 g/cm^3
3. 0.28 and 2.24 g/cm^3
4. 0.31 and 3.21 g/cm^3

67. The flux of carbon atoms during its steady state diffusion while carbonizing a steel plate on one side and decarburizing it on the other side is 2×10^{-10} g/cm^2-s. The diffusion co-efficient of carbon in steel at the carburizing temperature is 2.8×10^{-11} m^2/s. If the concentration of carbon at a depth of 10 mm beneath the carburizing surface is 0.75 kg/m^3, the concentration of carbon at a depth of 2 mm from the surface is closest to:

1. 0.80 kg/m^3
2. 1.20 kg/m^3
3. 1.32 kg/m^3
4. 2.10 kg/m^3

68. The cooling cure of a Pb-Sn alloy shows that the first solid nucleates at 250°C. The isothermal line at 250°C touches the liquidus line corresponding to Sn content of 30 wt%. The amount of the solid phase which is formed prior to eutectic reaction is closest to:

1. $f_\alpha = 25\%$
2. $f_\alpha = 75\%$
3. $f_\alpha = 10\%$
4. $f_\alpha = 5\%$



69. 5 g of a powder (with apparent density of 4.3 g/cm^3) is fed into a compaction die having 10 mm diameter. The powder is then compacted to a green density of 6.6 g/cm^3 using an uniaxial single action press (pressing by upper punch only). Assuming no mass loss and neglecting elastic spring back effect during compaction, the upper punch will travel by a height of:

1. 5.16 mm 2. 9.65 mm 3. 14.81 mm 4. 15.35 mm

70. The elastic modulii of Al and SiC fibers are 69.0 GPa and 406.0 GPa, respectively, and the corresponding densities are 2.70 Mg/m^3 and 3.05 Mg/m^3, respectively. The specific modulus for an Al-matrix with 20 vol% of aligned continuous SiC fiber is:

1. 10.1 GPa/Mg/m^3
2. 3.4 GPa/Mg/m^3
3. 49.2 GPa/Mg/m^3
4. 84.4 GPa/Mg/m^3

71. At 300K calculate the density of conduction electrons in a silicon wafer doped with $2 \times 10^{16}/cm^3$ of Boron. (Intrinsic carrier density of Si at 300K is $9.65 \times 10^9/cm^3$)

1. $5 \times 10^3/cm^3$
2. $10^{10}/cm^3$
3. $2 \times 10^{12}/cm^3$
4. $10^{20}/cm^3$

72. In a super conducting wire-loop, the current flow decays following the equation $i_t = i_0.exp\left[-\frac{R}{L}t\right]$ where, R and L represent resistance and self inductance, respectively. The self-inductance of half a meter super conductor wire-loop having wire diameter of 1.2 mm is found to be $2 \times 10^{-6}\ \Omega{\cdot}s$. The maximum resistance that this superconductor loop should possess to maintain a current flow of 1A for 1 year with 2% decay will be:

1. $4.04 \times 10^{-8}\ \Omega$
2. $3.07 \times 10^{-14}\ \Omega$
3. $1.28 \times 10^{-15}\ \Omega$
4. $2.48 \times 10^{-13}\ \Omega$

73. The critical resolved shear stress of a metal is 2.0 MPa. During plastic deformation of a single crystal of this metal, the slip plane rotates in a manner so that the angle between the tensile axis and the slip direction changes from 45° to 30°. If the angle between the normal to the slip plane and the tensile axis remains unaltered at 60°, the tensile stress changes as follows:

1. Increased by 1.04 MPa
2. Decreased by 1.04 MPa
3. Increased by 0.16 MPa
4. Decreased by 0.16 MPa