ACE
Engineering Academy

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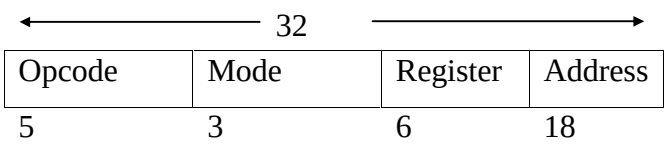
ESE- 2018 (Prelims) - Offline Test Series-Test-11

ELECTRICAL ENGINEERING

SUBJECT: ENGINEERING MATHEMATICS + COMPUTER FUNDAMENTALS SOLUTIONS

01. Ans: (b)

Sol:



02. Ans: (b)

Sol: 1206 Byte is available in 75^{th} Block

16)1206(75
112
86
80
06

Expression is K Mod C

75 Mod 64 = 11

03. Ans: (d)

Sol: Six processes arrive per minute

Each process requires 8 sec of Service Time (S.T.)

$6 \times 8 = 48$ sec

CPU is busy for 48 sec out of 60 sec

$$\% \text{ CPU utilization} = \frac{48}{60} = \frac{4}{5} = 0.8 = 80\%$$

04. Ans: (d)

Sol: 512 MB with Row size of 32 bit is 128 M × 32 bits

- Number of Rows: 128×10^6

Total time for all Rows is $128 \times 10^6 \times 10^{-9}$ sec = 128 ms

05. Ans: (a)

Sol: Average time = T_s + time for half revolution + time to read a sector is

$$T_a = T_s + \frac{1}{2R} + \frac{N_S}{N_t} \times \frac{1}{R}$$

06. Ans: (a)

Sol: Address field in the instruction is used to specify Memory Address or one of the processor Register Address.

For example to specify R_5 in a processor which is having 16 Registers from R_0 to R_{15}, it's Address field is '0101', and for implied Register; no address is specified in the instruction.

07. Ans: (c)

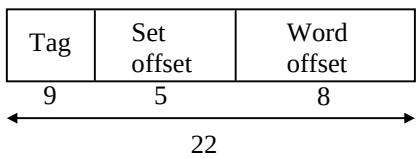
08. Ans: (c)

09. Ans: (c)

Sol: Main memory size $= 2^{14} \times 2^8 B = 2^{22} B$

Number of cache sets $= \frac{128}{4} = 32 = 2^5$

Number of words/Block $= 256 = 2^8$



10. Ans: (c)

Sol: $\log_2\left(\frac{M}{C}\right) = \log_2\left(\frac{4096}{512}\right) = \log_2 8$

$= \log_2 2^3$

$= 3\log_2 2 = 3$

11. Ans: (a)

12. Ans: (a)

Sol: In paging, process pages can be stored anywhere in the memory.

Page table is usually stored in memory in the form of pages.

13. Ans: (d)

Sol: Number of chips $= \frac{\text{Total capacity}}{\text{1 chip capacity}}$

$= \frac{4096\,\text{Bytes}}{256 \times 1\text{bit}}$

[Default unit of storage is bits]

$= \frac{4096 \times 8\,\text{bits}}{256 \times 1\,\text{bit}} = \frac{2^{12} \times 2^3}{2^8 \times 1} = 2^7 = 128$

14. Ans: (c)

Sol: Disk scheduler is a part of I/O subsystem of OS.

15. Ans: (b)

Sol: OS keeps 1 page table entry for each page in page table.

16. Ans: (b)

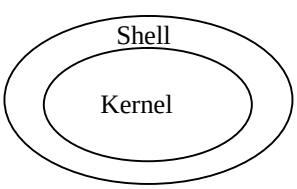
Sol: Optimal page replacement policy gives minimum page faults.

17. Ans: (b)

Sol: Interrupts are not allowed in non-preemptive multiprogramming. Number of processes in main memory is known as degree of multiprogramming.

18. Ans: (d)

Sol: GUI is the part of shell in OS.



19. Ans: (d)

Sol: In paging $\Rightarrow$ Page table

In segmentation $\Rightarrow$ Segment table

For particular implementation either of these two is used.

20. Ans: (b)

21. Ans: (a)

Sol: In one folder two files of same type can not have same name.

22. Ans: (c)

Sol: Cache is known as on-chip or on-board memory.

23. Ans: (c)

Sol: In fixed or variable partition allocation degree of multiprogramming is restricted by number of partitions.

24. Ans: (a)

Sol: Before compilation, some sort of processing is carried out known as pre-processing. In pre-processing stage, all macro calls are substituted with their corresponding macro body.

S = 5+1*5+1;

S = 11

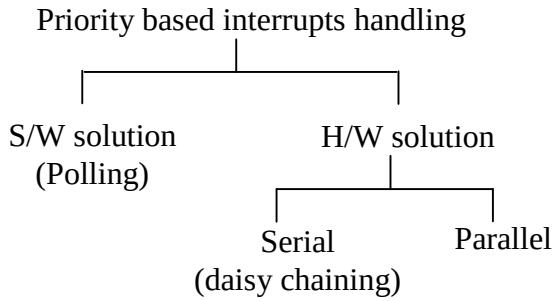
25. Ans: (d)

Sol: All statements are true.

26. Ans: (a)

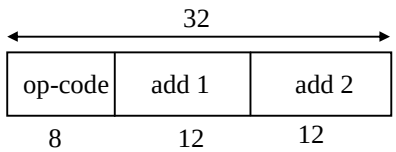
27. Ans: (a)

Sol:



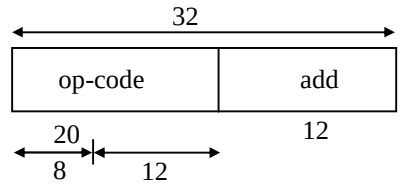
28. Ans: (b)

Sol: 2-addresses instruction



Max op-code combinations	$=2^8$	= 256
Used op-code combinations		= 254
Unused op-code combinations		=2

1-addresses instruction



Maximum 1-add instructions = 2×2^{12}

$= 2^{13}$

29. Ans: (a)

Sol: To read 32-bits or 4 Bytes memory, time required = 40 nsec

To read 1024 Bytes memory, time required

$= \frac{40\,\text{n sec}}{4\,\text{Bytes}} \times 1024\,\text{Bytes} = 10240$ nsec

$= 10.24$ μsec

30. Ans: (a)

31. Ans: (b)

Sol: Transport Layer = End-to-End Layer = Host-to-Host Layer

32. Ans: (b)

Sol: Given:

$u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$

$u_x = 3x^2 - 3y^2 + 6x$

$u_y = -6xy - 6y$

Now, $dv = v_x\,dx + v_y\,dy$

$dv = -u_y\,dx + u_x\,dy$

$dv = (6xy + 6y)\,dx + (3x^2 - 3y^2 + 6x)\,dy$

$\int dv = \int (6xy + 6y)\,dx$ (integrating partially w.r.t x)

$+ \int_C (3x^2 - 3y^2 + 6x)\,dy$ (integrating these terms which do not involve x)

$\therefore v = 3x^2y + 6xy - y^3 + C$

33. Ans: (c)

Sol: $(z^2 + 4)(z^2 - 9) = 0$

$\therefore z = \pm 2i, \pm 3$ are singular points

34. Ans: (b)

Sol: $f(z) = \dfrac{1 - e^{2z}}{z^4}$

$$= \frac{1}{z^4}\left\{1 - \left(1 + 2z + \frac{4z^2}{2!} + \frac{8z^3}{3!} + \ldots\ldots\ldots\right)\right\}$$

$$= \frac{1}{z^4}\left\{-2z - 2z^2 - \frac{4}{3}z^3 - \ldots\ldots\ldots\ldots\right\}$$

Residue of f(z) at $z = 0 = -\dfrac{4}{3}$

35. Ans: (c)

Sol: By the properties of modulus of z we have

$z_2\overline{z_2} = |z_2|^2$,

$|z_1 + z_2| \le |z_1| + |z_2|$,

$|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2|z_1|^2 + 2|z_2|^2$

$\therefore$ Option (c) is wrong.

(i.e., not a property of $|z|$)

36. Ans: (b)

Sol: Consider $\left|\frac{3+4i}{1-2i}\right| = \left|\frac{3+4i}{1-2i}\right|$

$\Rightarrow \left|\frac{3+4i}{1-2i}\right| = \frac{\sqrt{9+16}}{\sqrt{1+4}}$

$\left|\frac{3+4i}{1-2i}\right| = \frac{5}{\sqrt{5}} = \sqrt{5}$

37. Ans: (b)

Sol: Given that $f(z) = z + z^* = (x+iy) + (x-iy)$

$\hat{G}$ $f(z) = 2x$

But z^* is continuous and not analytic.

$\therefore$ f(z) is continuous but not analytic function.

38. Ans: (b)

Sol: i) Transfer one black ball from urn A to urn B and transfer one black ball from urn B to urn A.

ii) Transfer one white ball from urn A to urn B and transfer one white ball from urn B to urn A.

$\therefore P = \frac{3}{5}\times\frac{4}{10} + \frac{2}{5}\times\frac{6}{10} = \frac{12}{25}$

39. Ans: (b)

Sol: We know that $E(X^2) \ge (E(X))^2$

Let $E(X) = 2$ and $E(X^2) = 3$

$E(X^2) < (E(X))^2$

$\therefore$ Option (b) does not satisfy $E(X)^2 \ge (E(X))$

40. Ans: (c)

Sol: $P(b) = \frac{P(A)P\left(\frac{B}{A}\right)}{P\left(\frac{A}{B}\right)} = \frac{\frac{2}{3}\times\frac{1}{4}}{\frac{1}{2}} = \frac{1}{3}$

41. Ans: (c)

Sol: $P(x = 0) = P(x = 1)$

$\frac{e^{-\lambda}.\lambda^0}{0!} = \frac{e^{-\lambda}.\lambda^1}{1!} \Rightarrow \lambda = 1 \Rightarrow E(X) = 1$

$V(X) = 1$

$E(3x+5) = 3(E(x)+5 = 3(1)+5 = 8$

42. Ans: (c)

Sol; $E(x) = 4$; $V(x) = 9$

$E(y) = 0$; $V(y) = 1$

$y = ax - b$

$V(y) = a^2V(x)$

$1 = 9a^2 \Rightarrow a^2 = \frac{1}{9}$

$\Rightarrow a = \frac{1}{3}$

43. Ans: (b)

Sol: As per the definition of regression model.

44. Ans: (a)

Sol: Using Binomial Distribution

Required probability

$$= P(X=2) = 4_{C_2} \times \left(\frac{1}{2}\right)^2 \times \left(\frac{1}{2}\right)^2 = \frac{3}{8}$$

45. Ans: (b)

Sol: $|A| = 0$

$$\begin{vmatrix} 1 & \lambda & -1 \\ \lambda & -1 & -1 \\ 1 & 1 & -\lambda \end{vmatrix} = 0$$

$\Rightarrow (\lambda + 1) - \lambda(-\lambda^2 + 1) - (\lambda + 1) = 0$

$\Rightarrow -\lambda(-\lambda^2 + 1) = 0$

$\Rightarrow \lambda = 0, 1, -1$

$\therefore$ For three values of λ, it has non trivial solution

46. Ans: (c)

Sol: Let the order of matrix A be m×n. Matrix multiplication is possible only when number of columns of first matrix is equal to number rows of second matrix

$(1\ \ 2\ \ 3)A = (1\ \ 3\ \ 4\ \ 6\ \ 1)$

$1\times 3.\ m\times n = 1\times 5$

$1\times n = 1\times 5 \quad (\because m = 3)$

$n = 5$

$\therefore$ The order of A is 3×5

47. Ans: (a)

Sol: $AA^T = I$

$|AA^T| = |I|$

$|A|\,|A^T| = 1$

$|A|^2 = 1 \qquad (\because |A| = |A^T|)$

$\therefore |A| = \pm 1$

48. Ans: (c)

Sol: We know that a matrix A of order 5 has five eigen values.

But given that three eigen values are zeros

$\Rightarrow$ Out of five eigen values, two eigen values are non-zero eigen values.

But we know that, the number non-zero eigen values is same as rank of that matrix A.

$\therefore$ The rank of matrix A is 2

49. Ans: (a)

Sol: Consider matrix

$$A = \begin{bmatrix} 1 & -4 & 3 \\ 2 & -5 & 3 \\ 1 & 4 & 0 \end{bmatrix} \sim \begin{bmatrix} 1 & -4 & 3 \\ 0 & 3 & -3 \\ 0 & 8 & -3 \end{bmatrix} \sim \begin{bmatrix} 1 & -4 & 3 \\ 0 & 3 & -3 \\ 0 & 0 & 15 \end{bmatrix}$$

$\Rightarrow \rho(a) = 3$

Here the rank of a matrix A is same as the number given vectors.

$\therefore$ The given three vectors are linearly independent vectors

Hence option (a) is correct.

50. Ans: (a)

Sol: Given that the eigen values of A are $\lambda = 1, -2, 4$

$\Rightarrow$ The eigen values of A^2 are $\lambda^2 = (1)^2, (-2)^2, (4)^2$

But the eigen values of $I_{3\times3}$ are 1, 1, 1.

If 'λ' is the general eigen value of $A_{3\times3}$ matrix then $2 + 3\lambda + \lambda^2$ is the general form an eigen value of matrix of the form $2I + 3A + A^2$.

Here one of the eigen value of the matrix $2I + 3A + A_2$ is zero.

$\therefore$ The matrix $2I + 3A + A^2$ is singular matrix

51. Ans: (c)

Sol: Given that $|A_{4\times4}| = 24$

we know that $|adj(A_{n\times4})| = |A|^{(n-1)}$

$\Rightarrow |adj(A_{4\times4})| = |A|^{(4-1)}$

$\Rightarrow |adj(A_{4\times4})| = A|^3 = (25)^3$

$\therefore |adj(A_{4\times4})| = 15{,}625$

52. Ans: (a)

Sol: Given matrix is $A = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$

Consider $|A - \lambda I| = 0$

$$\Rightarrow \begin{vmatrix} 3-\lambda & 2 \\ 2 & 3-\lambda \end{vmatrix} = 0$$

$\Rightarrow \lambda^2 - 6\lambda + 5 = 0$

$\Rightarrow \lambda = 1, 5$ are eigen values

$\therefore$ The larger of the two eigen values of the matrix A is 5.

53. Ans: (c)

Sol: Given $\left(\frac{d^2y}{dx^2}\right)^2 = \left[x + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}$

Squaring both sides, we get

$$\left(\frac{d^2y}{dx^2}\right)^4 = \left\{\left[x + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}\right\}^2$$

$$\Rightarrow \left(\frac{d^2y}{dx^2}\right)^4 = \left[x + \left(\frac{dy}{dx}\right)^2\right]^3$$

Order = 2 and Degree = 4

54. Ans: (c)

Sol: Given $x\frac{dy}{dx} + y = 0$, $y(2) = -2$

$$x\frac{dy}{dx} = -y$$

$$\Rightarrow \frac{dy}{y} = -\frac{dx}{x}$$

$$\Rightarrow \frac{dy}{y} + \frac{dx}{x} = 0$$

Integrating both sides

$$\int\frac{dy}{dx} + \int\frac{dx}{x} = \int 0$$

$$\Rightarrow \log y + \log x = c$$

$$\Rightarrow xy = c$$

at x = 2 and y = –2 $\Rightarrow$ c = – 4

$\therefore$ The solution is xy = – 4

55. Ans: (b)

Sol: Given $\frac{dy}{dx} = \frac{2x}{x^2 + y^2 - 2y}$

$$\Rightarrow (x^2 + y^2 - 2y)dy = 2xdx$$

$$\Rightarrow (x^2 + y^2)dy - 2ydy - 2xdx = 0$$

$$\Rightarrow (x^2 + y^2)dy - d(x^2 + y^2) = 0$$

$$\Rightarrow dy = \frac{d(x^2 + y^2)}{(x^2 + y^2)}$$

$$\Rightarrow \int dy = \int\frac{d(x^2 + y^2)}{(x^2 + y^2)}$$

$\therefore$ The solution is $y = \log(x^2 + y^2) + C$

56. Ans: (b)

Sol: Given $y^{11} + y = 0$

$$\Rightarrow \frac{d^2y}{dx^2} + y = 0$$

The auxiliary equation is

$D^2 + 1 = 0$

$\Rightarrow D = \pm i$ are roots

The solution is

$y = c_1\cos x + c_2\sin x$ ……. (1)

$y(0) = 1$, (1) $\Rightarrow 1 = c_1\cos(0) + c_2\sin(0)$

$\Rightarrow c_1 = 1$

$$y\left(\frac{\pi}{2}\right) = 2$$

$$(1) \Rightarrow 2 = c_1\cos\left(\frac{\pi}{2}\right) + c_2\sin\left(\frac{\pi}{2}\right)$$

$2 = C_2$

$\therefore$ The solutions is

$y = \cos x + 2 \sin x$

57. Ans: (d)

Sol: $(1+t)\frac{dy}{dt} = 4y$

$\int \frac{1}{y} dy = \int \frac{4}{1+t} dt$

$\log y = 4 \log (1+t) + \log c$

$y = c(1+t)^4$

$y(0) = 1 \Rightarrow 1 = c(1+0)^4 \Rightarrow c = 1$

$\Rightarrow y = (1+t)^4$

58. Ans: (b)

Sol: Order of convergence of secant method = 1.62

Order of convergence of method of false position = 1

Order of convergence of successive approximation method = 1

Bisection method is slowest of all the methods.

$\therefore$ Secant method has fastest rate of convergence

59. Ans: (c)

Sol: Let $x = \frac{1}{a} \Rightarrow \frac{1}{x} = a$

Let $f(x) = \frac{1}{x} - a = 0$

$f^1(x) = -\frac{1}{x^2}$

Newton – Raphson iteration formula is

$x_{k+1} = x_k - \frac{f(x_k)}{f^1(x_k)}$

$x_{k+1} = 2x_k - a.x_k^2$ .....(1)

60. Ans: (a)

Sol: $f(x) = x^3 - 10x^2 + 31x - 30 = 0$

Dividing f(x) by (x – 5)

$f(x) = (x-5)(x^2 - 5x + 6) = 0$

$\Rightarrow x = 5, 2, 3$

$\therefore$ The other two roots are 2 & 3

61. Ans: (d)

Sol: All the other methods, we need two initial values near the root.

62. Ans: (d)

Sol: $\lim_{x \to a-} [x] = a - 1$

$\lim_{x \to a+} [x] = a$

y $\lim_{x \to a} [x]$ does not exist

63. Ans: (d)

Sol: $f(x) = Ax^2 + Bx + C$

By Lagrange's Theorem,

$\left[\frac{f(b) - f(a)}{b - a}\right] = f'(\xi)$

$$\frac{\left(Ab^2+Bb+C\right)-\left(Aa^2+Ba+C\right)}{b-a}=2A\xi+B$$

$$\frac{A\left(b^2-a^2\right)+B(b-a)}{b-a}=2A\xi+B$$

$$A(b+a)=2A\xi$$

$$\therefore \xi=\frac{b+a}{2}\in(a,b)$$

64. Ans: (b)

Sol: Let $x^y + y^x = f(xy)$

$$\frac{dy}{dx}=-\frac{f_x}{f_y}=-\left[\frac{yx^{y-1}+y^x\log y}{x^y\log x+xy^{x-1}}\right]$$

$$\frac{dy}{dx}(1,1)=-\left[\frac{1+0}{1+0}\right]=-1$$

65. Ans: (a)

Sol: $f(x,y)=xy+(x-y)$

$$\frac{\partial f}{\partial x}=y+1=0,$$

$$\frac{\partial f}{\partial y}=x-1=0$$

$\Rightarrow x = 1, \quad y = -1$

At (1, –1)

r = 0, t = 0, s = 1

$rt - s^2 = 0 - 1$

$= -1 < 0$

$\therefore$ Saddle point is (1 , – 1)

66. Ans: (b)

Sol: The directional derivative of

$f(x,y,z) = x^2 - y^2 + 2z^2$ at P (1, 2, 3) in the direction of $\overrightarrow{PQ}$, where Q = (5, 0, 4), i.e., $\overrightarrow{PQ} = 4i - 2j + k$ is

$$(\text{grad}\,\phi)_P.\frac{\overrightarrow{PQ}}{\left|\overrightarrow{PQ}\right|}=(2xi-2yj+4zk)_P.\frac{4i-2j+k}{\sqrt{16+4+1}}$$

$$=(2i-4j+12k).\frac{(4i-2j+k)}{\sqrt{21}}$$

$$=\frac{8+8+12}{\sqrt{21}}=\frac{28}{\sqrt{21}}$$

67. Ans: (c)

Sol: If $\overline{V}$ is solenoidal, then

$\text{div}\ \vec{V} = 0$

$\Rightarrow 1 + 1 + a = 0$

$\Rightarrow a = -2$

68. Ans: (b)

Sol: By using gauss divergence theorem,

$$\iint_S(\vec{r}.\hat{n})ds=\iiint_V \text{div}(\vec{r})dv=\iiint_V 3\,dx\,dy\,dz$$

$= 3 \times$ volume of the unit sphere

$$=3\times\frac{4}{3}\pi(1)^3$$

$= 4\pi$

69. Ans: (a)

Sol: $f(x) = \dfrac{\sin x.\cos x}{|\cos x|}dx$

$$f(-x)=\frac{-\sin x.\cos x}{|\cos x|}$$

$= -f(x)$

$\therefore f(x)$ is a odd function

$\therefore f(x) = 0$

70. Ans: (c)

Sol: $L^{-1}\left\{\frac{s+1}{(s^2+2s)}\right\} = L^{-1}\left\{\frac{s+1}{s(s+2)}\right\}$

$= L^{-1}\left\{\frac{A}{s} + \frac{B}{(s+2)}\right\}$

where $A = \frac{1}{2}$ and $B = \frac{1}{2}$

$= \frac{1}{2}(1 + e^{-2t})$

71. Ans: (b)

Sol: By second shifting Theorem, we have

$L\{f(t-T)\} = e^{-sT} F(s)$

72. Ans: (a)

73. Ans: (d)

Sol: Multitasking OS uses Round-Robin scheduling for process execution.

74. Ans: (b)

Sol: Both Statements are correct but Statement (II) is not reason of Statement (I).

75. Ans: (a)

Sol: All files are contained in same directory, hence to uniquely identify a file, each file should have unique name.

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