Answer Key: EE-TS-1

1	C	2	B	3	A	4	B	5	B	6	D	7	B	8	C	9	C	10	B
11	C	12	C	13	D	14	C	15	A	16	B	17	A	18	B	19	C	20	B
21	A	22	A	23	A	24	B	25	B	26	A	27	B	28	D	29	C	30	C
31	C	32	A	33	B	34	C	35	C	36	B	37	A	38	A	39	B	40	C
41	C	42	D	43	A	44	A	45	B	46	B	47	A	48	A	49	B	50	A
51	C	52	A	53	B	54	A	55	B	56	D	57	A	58	C	59	A	60	B
61	C	62	B	63	B	64	D	65	C										

Explanation:

1. **[Ans .C]**
   At no load, power consumed = total loss
   Total loss = $(100 \times 2) - (2^2 \times 1) = 196\omega$
   At load, total loss = $196 + (4^2 \times 1) = 212\omega$
   Efficiency = $\frac{(100\times4) - 212}{(100\times4)} = \frac{188}{400} = 47\%$
2. **[Ans .B]**
3. **[Ans .A]**
   P = 200mω; $V_L = \frac{25k}{\sqrt{2}}$; $\cos\emptyset = 0.8$
   $I_L = \frac{P}{\sqrt{3}V_l\cos\emptyset} = \frac{200\times10^6}{\frac{25\times10^3}{\sqrt{2}}\times0.8} = 10\sqrt{2}kA$
4. **[Ans .B]**
5. **[Ans .B]**
6. **[Ans .D],**
   $Z^+ = 0$, ∴N = $-P^+$
   for stability, $P^+ = 0 \Rightarrow N = 0$
   For N=0, $\frac{kT_1T_2}{(T_1+T_2)} < 1$. Also, N=1
7. **[Ans .B]**
   For the statement (2), Z = $\sqrt{L/C}$
8. **[Ans .C]**
9. **[Ans .C],** $M = xy^2 + \lambda x^2 y$
   $N = (x + y)x^2$
   for exact differential equation
   $\frac{\partial M}{\partial y} = \frac{\partial N}{\partial x}$

$3x^2 + 2xy = 2xy + \lambda x^2$

$\Rightarrow \lambda = 3$

10. **[Ans .B]**
11. **[Ans .C]**
12. **[Ans .C]**
13. **[Ans .D]**
14. **[Ans .C],**

$\underset{z=1}{\text{Res}}\ f(z) = \underset{z\to 1}{\text{Lim}} \frac{d}{dz}\ [\ (z-1)^2 f(z)\ ]\ = \underset{z\to 1}{\text{Lim}} \frac{d}{dz} \left(\frac{50z}{(z+4)}\right)\ = 8$

15. **[Ans .A]**

Vertical amplifier has to handle fast varying signal where as horizontal amplifier has to handle. Sweeb signal which is relatively slow.

16. **[Ans .B]**
17. **[Ans .A],**

Thevenin's Circuit ⟷ **Source Conversion** ⟷ **Norton's circuit**

$I = {}^{5}/_{15} = {}^{1}/_{3}\ A$

$R = 15\Omega.$

18. **[Ans .B],**

$V_{0rms} = (V_S - 4)\sqrt{\frac{T_{ON}}{T}} = 196\sqrt{\propto} = \frac{196}{\sqrt{2}}$

$\Rightarrow \propto = {}^{1}/_{2}$

19. **[Ans .C]**
20. **[Ans .B]**
21. **[Ans .A]**

The loadline must interests all three portions of curve in order that UJT could work as an oscillator

22. **[Ans .A]**

$$\boldsymbol{Q = \frac{360}{T \times M} = 100}$$

↑ **No. of teeth** ↖ **No. of phase**

23. **[Ans .A],**

ROC should not contain any poles

24. **[Ans .B],** which leads to very low $f'(x_0)$

25. **[Ans .B],** $P = \frac{E^2}{R}$

$\log P = 2\log E - \log R$

$\frac{\delta P}{P} = 2\frac{\delta E}{E} - \frac{\delta R}{R}$

$\frac{\delta P}{P} \times 100 = 2\frac{\delta E}{E} \times 100 - \frac{\delta R}{R} \times 100$

$\frac{\delta P}{P} \times 100 = 2(3) - (-2) = 8$

26. **[Ans .A]**

27. **[Ans .B]**

$T = \frac{3V^2}{\omega_S I_2} \times S$

Since T is constant

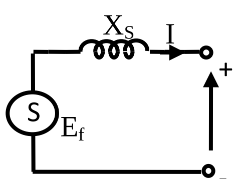
$\frac{S_1}{\omega_{S1}} = \frac{S_2}{\omega_{S2}}$

$\Rightarrow S_2 = \frac{\omega_{S2}}{\omega_{S1}} \times S$

$= \frac{60}{50} \times 0.04$

$= 0.048 = 4.8\%$

28. **[Ans .D]**



$V_t = 1$pu

$I = 0.9$pu

$\cos\phi = 1$

$E_f = JX_s I_a + V_t$

$= 1.02\angle 10.20^0$

New value of execute

emf = 1.52pu

active power delivered = 0.9pu

$\Rightarrow \frac{|V_t||E_f|}{X_s}\sin S = 0.9$

$\sin\delta = 0.118$

$\delta = 6.78^0$

$I_a = \frac{E_f - V_t}{JX_s} = 2.7\angle -70.56 \Rightarrow 70.56$ (lagging)

p.f = 0.33 lagging

29. **[Ans .C]**

Transformer efficiency is

$\eta = \frac{VI\cos\phi}{VI\cos\phi + P_{co} + I^2R_c}$

$= \frac{V\cos\phi}{V+\frac{P_{co}}{I}+IR_c}$

P_{co} = core loss

I^2R_c = copper loss = P_{cu}

$\Rightarrow \frac{600}{600+P_{co}+P_{cu}} = 0.96$

$P_{co} + P_{cu}$ = 25kw - - -- -- - - - - (1)

at 60% loading, core loss is constant

but copper loss $\propto I^2$

so $P_{cu1} = (0.6)^2 P_{cu} = 0.36P_{cu}$

$\eta_1 = \frac{360}{360+P_{co}+0.36P_{cu}} = 0.96$ - - - -- - - (2)

Solving (1) & (2), we get

P_{co} = 9.375kw

P_{cu} = 15.63kw

30. **[Ans .C]**
31. **[Ans .C]**
32. **[Ans .A]**

Since poles must be at s = 0, s = 5 & s = 40 so the equation becomes

$\frac{K}{s\left(1+\frac{s}{2}\right)\left(1+\frac{s}{40}\right)}$ - - - - - - (1)

now in bode plot at s = 5,

$20\log G(s)\big|_{s=5} = 40$

But from (1) at s = 5

$20\log\frac{K}{s}\Big|_{s=5} = 40$

$\Rightarrow$ K = 500

So $G(s) = \frac{500}{s(1+0.25)(1+0.0255)}$

33. **[Ans .B]**
34. **[Ans .C]**

Jacobian matrix size is (no of PQ buses) × 2 + no of pv buses

= 2 + 200 + 100 = 500

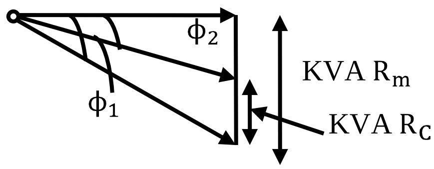
$\Rightarrow$ Size is 500 × 500

35. **[Ans .C]**

During positive cycle D1 is on & supply voltage appears across output. During negative cycle both diodes D1 & D2 are off till V_1 crosses 5V at that tine D2 turns ON but D1 is still off. So for whole negative cycle o/p voltage is undefined.

36. **[Ans .B]**
37. **[Ans .A]**

38. **[Ans .A]**
When V_{in} crosses 5V at wt = 45^0, the diode conducts & V_0 becomes negative. Before wt = 45^0, diode is off and voltage is positive again at ωt = 135, V_{in} becomes less than 5, o/p voltage becomes positive (+V) & remains until ωt = $\frac{9\pi}{4}$ where V_{in} once again becomes more than 5V.
39. **[Ans .B]**,
At $t = 0^-, V_c(0^-) = 5V \Rightarrow V_c(0^+) = 5v$
∴ $V_R\ (0^+) = {}^5/_4 = 1.25V$
As t→∞, $V_c(\infty) = 0$
Hence (B)
40. **[Ans .C]**



KVA R_m = KVAR of motor
= $KW_m \times \tan\phi_1$ = 30KVAR
From phasor diagram drawn, required KVAR of cap is
KVA R_C = 30- 19.37 = 10.63 KVA
so $KVAR_{C1} = \frac{10.63}{3} = \frac{(400)^2}{(1/\omega_c)^2}$
$\Longrightarrow$ C = 70.47μF
41. **[Ans .C],**
Apply voltage V_1 at input & short at output
$I_1 = \frac{V_1}{3}$
∴ $V_1 = 3I_2 + \frac{3V_1}{3}$
$\Longrightarrow V_1 = 3I_2 + V_1$
$\Longrightarrow I_2 = 0$
$Y = \infty$
also $I_1 = U\ I_2$
but $I_1 = \frac{V_1}{3}$ which is finite but I_2 = 0 from (1). It means U in equation(2) must be infinite for finite value of I_1
$U \rightarrow \infty$
42. **[Ans .D],**

$V_S\sqrt{\frac{C}{L}} < 10$

$\Rightarrow 100\times\sqrt{\frac{C}{100\times10^{-6}}} < 10 \;\Rightarrow\; 10^4 \times \sqrt{C}$

$\Rightarrow C < 1\ \mu F$

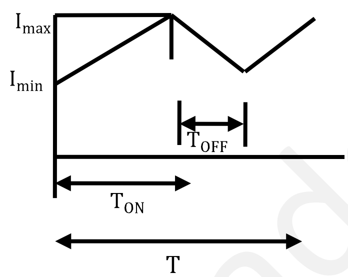
43. **[Ans .A]**

Average output voltage

$E = \propto V = V_0 = 0.2 \times 400$

$= 80V$

(Refer Fig)



$\frac{I_{max}-I_{min}}{T_{ON}} = \frac{32000}{6}$ - --- (1)

but $I_{max} - I_{min} = 10$ so (1) becomes

$T_{ON} = \frac{10}{5333.33}$

& T = 9.375ms

f= 106.67Hz

44. **[Ans .A]**

45. **[Ans .B],** $A = \begin{bmatrix} -1 & 2 & 3 \\ 0 & 4 & -1 \\ 0 & 0 & 1 \end{bmatrix}$

Eigen value of A are $\lambda_1 = -1$, $\lambda_2 = +1$, $\lambda_3 = 4$,

Eigen value of matrix $B = \lambda^3 + \lambda^2 + A + I$, are

$[\lambda_1]_B = \lambda_1^3 + \lambda_1^2 + \lambda_1 + 1 = 0$

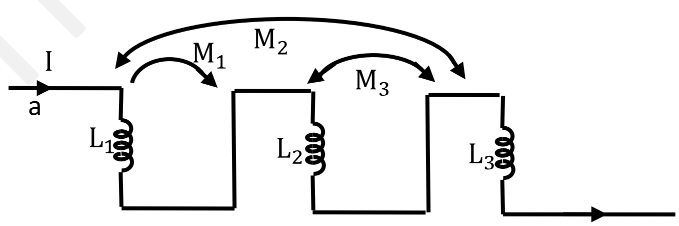
$[\lambda_2]_B = \lambda_2^3 + \lambda_2^2 + \lambda_2 + 1 = 4$

$[\lambda_3]_B = \lambda_3^3 + \lambda_3^2 + \lambda_3 + 1 = 85$

Trace of $B = [\lambda_1]_B + [\lambda_2]_B + [\lambda_3]_B = 89$

46. **[Ans .B]**

Since all coils are additive.



$V_{af} = L_1\frac{dI}{dt} + 2M_1\frac{dI}{dt} + L_2\frac{dI}{dt} + 2M_3\frac{dI}{dt} + 2M_2\frac{dI}{dt} + L_3\frac{dI}{dt}$

$= (L_1 + L_2 + L_3 + 2(M_1 + M_2 + M_3))\ \frac{dI}{dt}$

$L_{eff} = L_1 + L_2 + L_3 + 2(M_1 + M_2 + M_3)$

47. **[Ans .A]**

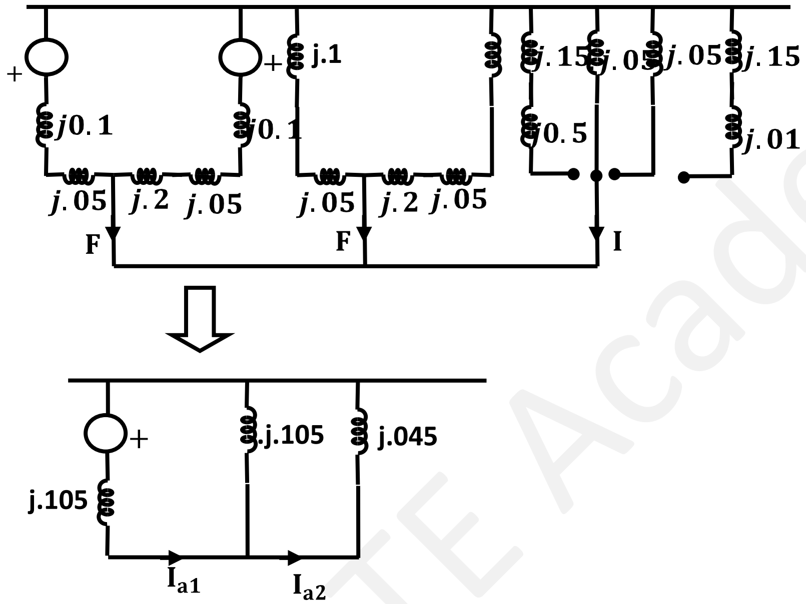
This is Anderson's bridge in which balanced equation 'S

$R_1 = \frac{R_2 R_3}{R_4} - r_1$

$= 3k\Omega$

48. **[Ans .A]**

49. **[Ans .B]**



I_{a1}= 7.326pu - $\angle - 90$

I_{a2} = - 2.198 $\angle - 90$

I_{a0} = - 5.128 $\angle - 90$

$$\begin{bmatrix} I_a \\ I_b \\ I_c \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ \propto^2 & \propto & 1 \\ \propto & \propto^2 & 1 \end{bmatrix} \begin{bmatrix} I_{a1} \\ I_{a2} \\ I_{a0} \end{bmatrix}$$

$I_C = \propto I_{a1} + \propto^2 + I_{a2} + I_{a0}$

$e^{j120} \times 7.326 \times e^{-j90} + e^{j240} \times -2.198 \angle e^{-j90}$

$7.326 \angle 30 - 2.198 \angle 150 - 5.128 \angle -90$

= 6.34 + j 3.663 + 1.9 – j 1.1 + j5.128

= 8.24 + j 7.691

= 11.27 $\angle 43^0$

= 11.27 $\times \frac{1200}{3300}$ KA

= 4.1KA

Now w.r. to generator 1

I_{a1} = 5.128$\angle - 90$

I_{a2} = - 1.539∠ − 90

$I_C = 5.128 \times \angle 30 - 1.539 \times \angle 150$

4.44 + j 2.564 + 1.33 - j.77

= 5.77 + j 1.7945

= 6.043 ∠17.27

$I_c = 6978A$

$I_f = 3I_{a0}$ = 15.384pu.

$= \frac{15.384 \times 1200}{\sqrt{3} \times 3300}$ KA = 3230A

50. **[Ans .A]**

51. **[Ans .C]**

p = 0.0005

n = 10, 000

m = np = 5

now probability that more than 2 student pass the exam.

= 1 – [probability that no one pass the entrance + probability that one pass the entrance + probability that 2 pass the entrance]

$= 1 - e^{-m} - m^1 e^{-m} - \frac{m^2 e^{-m}}{\angle 2}$

$= 1 - e^{-5} - 5e^{-5} - \frac{5 \times 5}{\angle 2} e^{-2}$

$= 1 - 6e^{-5} - 12.5e^{-5}$

= 1 – 18.5 e^{-5} = 87.5%

Similarly for more than one student passing the entrance.

$P = 1 - 6e^{-5} = 96.0\%$

52. **[Ans .A]**

53. **[Ans .B]**

At no load flux per pole

$\phi_1 = \frac{K_N E_a}{n}$

$= K_N \times \frac{249.2}{1200}$ ---------- (1)

Now when shaft is loaded the resultant flux/pole

$\phi_2 = K_N \times \frac{230}{1150}$ ---------- (2)

% reduction $\frac{\phi_1 - \phi_2}{\phi_1} \times 100$

From (1) & (2)

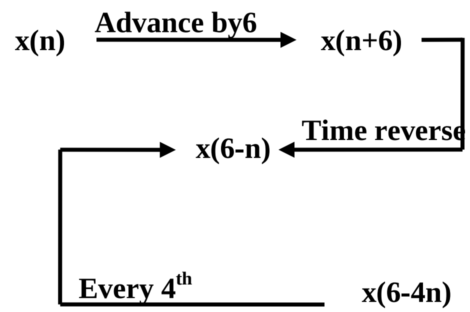
% reduction = $\frac{\frac{249.2}{1200} - \frac{230}{1150}}{\frac{249.2}{1250}}$ = 3.851

No load loss = $E_a \times I_a$

$= 249.2 \times 1.6$

= 398.72ω

54. **[Ans .A]**



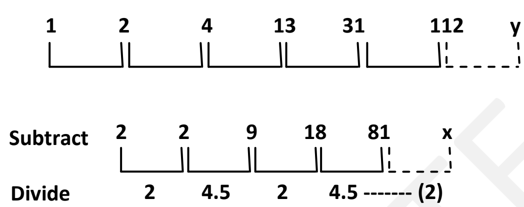
55. **[Ans .B],**

$Y(n) = X(4n-6)$

$Y(e^{J\omega}) = e^{-J\omega}.{}^{6}/_{4}.X(e^{J\omega/4})$

$\Rightarrow |Y(e^{J\omega})| = \left|X\left(e^{\frac{J\omega}{4}}\right)\right|$

56. **[Ans. D]**



81 × 2 = x

112 + 81 × 2 = y = 274

57. **[Ans. A]**

As the fruit seller is buying equal lots, we will have to make number of oranges of both the lots equal. Also, since he is selling all the orange, we will have to make the number of oranges brought and sold equal.

∴ L.C.M of 5, 4, 9 = 180.

The fruit seller is buying two lots of oranges, each lot having 180 oranges.

∴ 1^{st} lot = 36 Rs. ⇒ Total spent = 45 + 36 = 81 Rs.

2^{nd} lot = 45 Rs.

The fruit seller sells 9 oranges for 2 Rs. Therefore 560 Oranges for 80 Rs.

∴ Loss of 1 Rupee as loss % = $\frac{1}{81} \times 100 = 1.23\%$.

58. **[Ans. C]**
59. **[Ans. A]**
60. **[Ans. B]**

Choices A & C do not state the comparison logically. The expression ***as old as*** indicates equality of age, but the sentence indicates that the Brittany monuments predate the Mediterranean monuments by 2,000 years.

In B, the best choice, ***older than*** makes this point of comparison clear. B also correctly uses the adjective

61. **[Ans. C]**
62. **[Ans. B]**
63. **[Ans. B]**

In one day X can finish $1/15^{th}$ of the work
In one days Y can finish $1/10^{th}$ of the work.
Let us say that in one day Z can finish 1/2th of the work.
When all the three work together in one day they can finish $\frac{1}{15}+\frac{1}{10}+\frac{1}{Z}=\frac{1}{5}$ of the work

$\therefore \frac{1}{2}=\frac{1}{30}$

$\therefore$ Ratio of efficiencies = $\frac{1}{5}:\frac{1}{10}:\frac{1}{30}=2:3:1$.

$\therefore$ Z receives $1/6^{th}$ of the total money.

$\therefore$ Accordingly money is divided as 240: 360 : 120.

$\Rightarrow$ Z = 120

64. **[Ans. D]**

The probability that a customer entered the store makes a purchase = 0.4.

$\Rightarrow$ 2 customers make a purchase and one does not is $(0.4)^2 \times 0.6$

The two of the three people can be selected in ${}^3c_2$ or 3 ways.

$\therefore$ Required probability = $3 \times 0.4^2 \times 0.6 = 0.288$.

65. **[Ans. C]**

$$\left.\begin{matrix} E_1, E_2, E_3 & \rightarrow \text{English men} \\ F_1, F_2, F_3 & \rightarrow \text{French men} \end{matrix}\right\} \quad \left.\begin{matrix} 1.\ E_1 \leftrightarrow E_2 \\ E_2 \leftrightarrow E_3 \\ F_1 \leftrightarrow F_2 \\ F_2 \leftrightarrow F_3 \\ F_3 \leftrightarrow E_3 \\ E_3 \leftrightarrow E_2 \\ E_2 \leftrightarrow E_1 \\ F_3 \leftrightarrow F_2 \\ F_1 \leftrightarrow F_1 \end{matrix}\right\} \text{9 calls}$$