ACE Engineering Academy
Leading Institute for ESE/GATE/PSUs

DEEP LEARN

HYDERABAD | DELHI | PUNE | BANGALORE | LUCKNOW | CHENNAI | VISAKHAPATNAM | VIJAYAWADA | TIRUPATHI | KOLKATA | AHMEDABAD

ESE-2021

PRELIMINARY EXAMINATION

QUESTIONS WITH DETAILED SOLUTIONS

ELECTRICAL ENGINEERING

ACE Engineering Academy has taken utmost care in preparing the ESE-2021 Prelims Examination solutions. Discrepancies, if any, may please be brought to our notice. ACE Engineering Academy do not owe any responsibility for any damage or loss to any person on account of error or omission in these solutions. ACE Engineering Academy is always in the fore front of serving the students, irrespective of the examination type (GATE/ESE/PSUs/PSC/GENCO/TRANSCO etc.,).

All Queries related to ESE-2021 Prelims Solutions are to be sent to the following email address hyderabad@aceenggacademy.com

Contact Us : 040-23234418,19,20

ESE - 2021 Preliminary Examination
Electrical ENGINEERING

SET - B

SUBJECTWISE WEIGHTAGE

S.No.	Name of the Subject	No. of Questions
01	Engineering Mathematics	15
02	Electrical Materials	13
03	Electric Circuits & Fields	16
04	Electrical & Electronic Measurements	13
05	Computer Fundamentals	9
06	Basic Electronics Engineering	11
07	Analog & Digital Electronics	12
08	Systems & Signal Processing	10
09	Control Systems	13
10	Electrical Machines	15
11	Power Systems	12
12	Power Electronics & Drives	11
Total No. of Questions		**150**

01. What is the line energy of dislocation on BCC iron? The Burgers' vector in iron is of the $\frac{1}{2}$ < 111 > type. The shear modulus of iron is 80.2 GN/m^2. Given that the lattice parameters of BCC iron,. a = 2.87 A.

(a) 1.40×10^{-9} J/m (b) 3.12×10^{-9} J/m
(c) 2.476×10^{-9} J/m (d) 6.544×10^{-9} J/m

01. Ans: (c)

Sol: Line energy of dislocation = $E = \frac{1}{2}Gb^2$

G = shear modular

b = magnitude of burges vector

$= \frac{a}{2}(h^2 + k^2 + R^2)^{1/2}$

$= \frac{2.87}{2}(1^2 + 1^2 + 1^2)^{1/2}$

$= 2.4854 \times 10^{-10}$

$= \frac{1}{2} \times 80.2 \times 10^9 \times (2.4854 \times 10^{-10})^2$

$= 2.47.7 \times 10^{-11}$

$= 2.47 \times 10^{-9}$ J/m

02. Nichrome is an alloy of

(a) Mangenese 2.5%, Nickel 81% to 84%, Chromium 14% to 17% and a little percentage of Iron
(b) Mangenese 2.0%, Nickel 78% to 81%, Chromium 17% to 20% and a little percentage of Iron
(c) Mangenese 1.5%, Nickel 75% to 78%, Chromium 20% to 23% and a little percentage of Iron
(d) Mangenese 0.5%, Nickel 72% to 75%, Chromium 23% to 26% and a little percentage of Iron

02. Ans: (b)

Sol: Nichrome is an alloy of
Nickel = 78 % to 81%
Chromium = 17% to 20%
Manganese = 2.0%

03. Which one of the following statements is **not** correct regarding bundle conductors?

(a) Voltage stress at the conductor surface is reduced by using bundle conductors.
(b) Corona loss is smaller by using bundle conductors
(c) Current carrying capacity is decreased in bundle conductors as compared with a single conductor of equivalent cross-sectional area
(d) The line having bundle conductors is less liable to cause radio interference.

03. Ans: (c)

Sol: Bundle conductors are introduced into power system with the following objectives.

1. Reducing corona loss by reducing 'E' on conductor surface.
2. Reducing Radio interference on communication system

Generally bundle conductor system designed to replace the single conductor system to meet above objectives.

The conditions in that conversion will be same voltage rating and power ratings. So, current rating of bundle condcutor system and its equivalent single conductor system are equal.

From options given, options (a), (b) and (d) are correct. Option (c) is incorrect with respect to bundle conductors.

So, correct answer will be (c).

ACE Engineering Academy Since 1995 Leading Institute for ESE/GATE/PSUs x DEEP LEARN

DEEP LEARN PRE-RECORDED VIDEOS

ONLINE COURSES

CE | ME | EC | EE | CSIT | IN | PI

- for **ESE | GATE | SSC | PSUs** curated by India's best minds. Access courses through Mobile/Tablet from anywhere.
- We have subscriptions options of 1 Month, 3 Months, 6 Months, 12 months, 18 months and 24 months.

RECORDED VIDEO LECTURES

- GATE + PSUs (650+ Hours*) English
- GATE + PSUs (650+ Hours*) Hinglish
- ESE : General Studies (250+ Hours*)
- SSC-JE : Technical (Civil) (400+ Hrs*)
- ESE + GATE + PSUs (1000+ Hours*)
- SSC-JE : GS (200+ Hours*)
- APPSC / TSPSC - Technical (400+Hours) (Telugu + English)
- APPSC / TSPSC - GS - (250+Hours) (Telugu + English)
- GENCO / TRANSCO -(600+Hours) (Telugu + English)
- Subject wise courses available for SSC - JE : GS & Technical (Civil).
- Subject wise courses available for GATE / ESE (Hinglish).

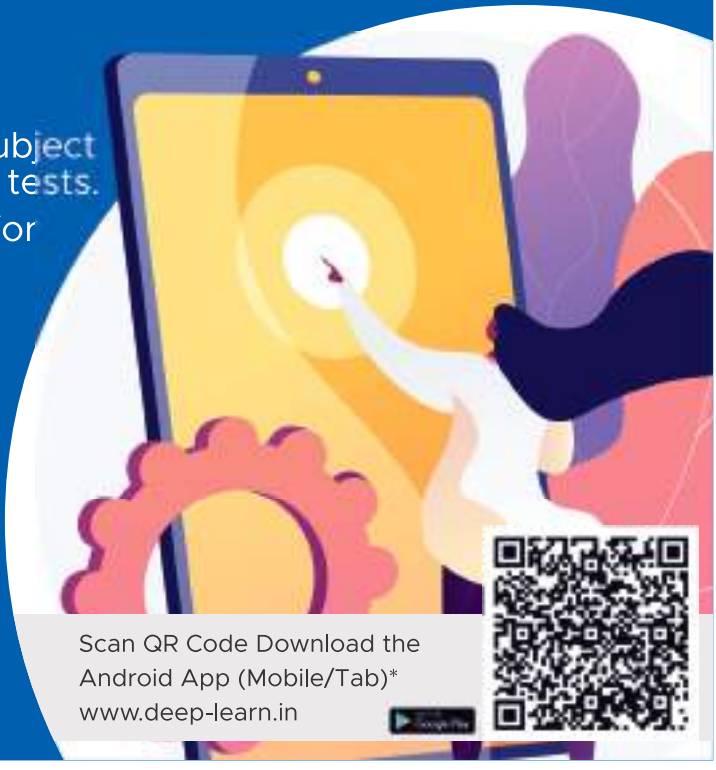
SALIENT FEATURES

Get **10% DISCOUNT**

USE CODE: **ESE10**

Valid Till: 30th July 2021

- Dynamic & Experienced Faculty.
- Covers Exam Preparation Strategy and Live Doubt clearing sessions.
- Facilitates Enhanced learning by incorporating 2d & 3d animations.
- Free Online Test Series (Total 117 tests, subject wise, sectional wise, and full length mock tests.
- Compose online study notes and save it for future reference.
- Comprises of weekly self assessment tests.
- Free Interview Guidance & Post GATE Guidance for subscribers.
- ASK AN EXPERT feature for doubt clarifications via emails/video (services to be availed within 12 hrs.)
- Procure Full set of Study Material (Optional)*
- EMI option available.



Scan QR Code Download the Android App (Mobile/Tab)*
www.deep-learn.in

04. What is the loss of energy per hour in a ferromagnetic specimen when it is subjected to 50 Hz magnetisation, if the specimen weighs 50 kg, area of hysteresis loop is 200 joules per m^3 and density of iron is 7500 kg/m^3 ?

(a) $2{\cdot}4 \times 10^5$ J (b) $3{\cdot}9 \times 10^4$ J

(c) 2.9×10^4 J (d) $4{\cdot}5 \times 10^5$ J

04. Ans: (a)

Sol: f = 50 Hz

m = 50 kg

Hysteresis loop area = B × H = 200 J/m^3

density = ρ = 7500 kg/m^3

Loss of energy $E = \frac{200 \times 50}{7500} \times 50$

$= 66.66$ J/sec

$= 66.66 \times 60 \times 60$

$= 2.4 \times 10^5$ J

05. A heater element is made of nichrome wire having resistivity equal to 100×10^{-8} Ωm. The diameter of the wire is 0·4 mm. The length of the wire required to get a resistance of 40 Ω and 1000 W is

(a) 5.0 meters (b) 4.5 meters

(c) 5.5 meters (d) 4.0 meters

05. Ans: (a)

Sol: $\rho_{Nichrome} = 100 \times 10^{-8}$ Ωm

d = 0.4 mm

R = 40 Ω

ℓ = ?

$A = \pi(0.2 \times 10^{-3})^2$

$= \pi(0.2)^2 \times 10^{-6}$

$= 0.1256 \times 10^{-6}$

$\rho = \frac{RA}{\ell} = 100 \times 10^{-8} = \frac{40 \times \frac{\pi}{4}(0.4 \times 10^{-3})^2}{\ell}$

$\ell = 0.05 \times 10^2 = 5$m

06. The lead material works as superconductor at a temperature of T_c = 7·26 K. If the constant characteristics of the lead material at 0 K is $H_o = 8 \times 10^5$ A/m, then what is the magnetic field in the lead at 5 K?

(a) $\frac{8 \times 10^5}{\pi}$ A/m (b) $\frac{4 \times 10^5}{4\pi}$ A/m

(c) $\frac{10^5}{2\pi}$ A/m (d) $4\pi \times 10^5$ A/m

06. Ans: (none)

Sol: $T_C = 7.26$ K

T = 5 K

$H_0 = 8 \times 10^5$ A/m

$H_T = H_0\left[1 - \left(\frac{T}{T_C}\right)^2\right]$

$= 8 \times 10^5\left[1 - \left(\frac{5}{7.26}\right)^2\right]$

$= 4.205 \times 10^5$ A/m

07. What is the approximate lattice constant "a" of a substance having FCC lattice, molecular weight 60.2 and density 6250 kg/m^3? (Consider N = 6.02×10^{26} kg-mole)

(a) 5×10^{-10} m (b) 3×10^{-10} m

(c) 4×10^{-10} m (d) 8×10^{-10} m

07. Ans: (c)

Sol: FCC lattice ($4R = \sqrt{2}\,a$) (n = 4)

Atomic weight A_W = 60.2 g/mol

density ρ = 6250 kg/m^3 = 6.25 g/cm^3

$N = 6.02 \times 10^{26}$/kg-mole

$= 6.02 \times 10^{23}$/mole

Volume of FCC = $V = a^3$

Theoretical density $\rho = \frac{n \times A_W}{A_N \times \text{Volume}}$

$= \frac{4 \times 60.2}{6.02 \times 10^{23} \times a^3}$

$= 6.25$

$a^3 = 64 \times 10^{-24}$ cm^3

$a = 4 \times 10^{-8}$ cm

08. Which one of the following statements is not correct regarding dielectric loss?
(a) The loss increases proportionately with the frequency of applied voltage
(b) Pressure of humidity increases the loss
(c) Temperature rise normally decreases the loss
(d) Votlage increase causes increased dielectric loss

08. Ans: (c)

Sol: The dielectric loss increases with increasing temperature because of increasing polarisation and that leads to more dielectric loss.

09. In a ferromagnetic material, the losses due to hysteresis are
(a) directly proportional to the supply frequency
(b) inversely proportional to the supply frequency
(c) inversely proportional to square of the supply frequency
(d) directly proportional to square of the supply frequency

09. Ans:(a)

Sol: Hysteresis loss = $W_h = K_h f(B_m)^{1.6}$ watts
K_h = Hysteresis constant
f = frequency
B_m = Magnetic flux density
$W_h \propto f$

10. Which one of the following statements is not correct regarding tungsten, which is used as filament material?
(a) It has the highest melting point amongst all metal
(b) It can be drawn into very thin wires
(c) It has very high tensile strength in its thinnest form.
(d) It becomes brittle at high temperature

10. Ans:(d)

Sol: Properties of tungsten:
1. Highest melting point amongst all metal
2. It can be drawn into thin wires
3. It has very high tensile strength
4. It follows ductile to brittle transmition phenomenon so at high temperature it ductile in nature.

11. The spontaneous magnetization is the most important characteristic of
(a) paramagnetic materials
(b) ferromagnetic materials
(c) diamagnetic materials
(d) permalloy

11. Ans: (b)

Sol: The spontaneous magnetization is present in ferro magnetic material and ferrimagnetic material.

12. What is the temperature coefficieny of resistance of material used in a resistor if the resistance at 25° C is 50 Ω and at 70° C is 57.2 Ω?
(a) $\frac{1}{168.5}$ (b) $\frac{1}{378.5}$
(c) $\frac{1}{463.5}$ (d) $\frac{1}{287.5}$

12. Ans:(d)

Sol: $T_1 = 25\ °C$, $R_1\ 50\Omega$, $T_2 = 70\ °C$, $R_2 = 572\ \Omega$
$R_2 = R_1[1 + \alpha(T_2 - T_1)$
$57.2 = 50[1 + \alpha(70 - 25)]$
$\alpha = 0.0032$

13. One of the primary purposes of using feedback in control systems is to
(a) increase the sensitivity of the system to parameter variations.
(b) reduce the sensitivity of the system to parameter variations.
(c) increase the effect of distortion.
(d) reduce the bandwidth of the system.

13. Ans: (b)

Sol: Feedback reduces output sensitivity to parameter variations.

$S_G^C = \frac{1}{1+GH}$ C = output
G = forward path TF
H = Feedback

If H = 0, sensitivity is 100 %, in the H, $S_G^C < 1$, Hence reduces the output variation with request to system parameter changes.

14. Transfer function of the system is given by

$G(s) = \frac{1000}{(1+0.1s)(1+0.001s)}$.

The corner frequency ω_1 and ω_2 for the system are respectively,

(a) 2 rad/sec and 4 rad/sec
(b) 8 rad/sec and 10 rad/sec
(c) 100 rad/sec and 10 rad/sec
(d) 10 rad/sec and 1000 rad/sec

14. Ans: (d)

Sol: corner frequencies $\omega_1 = \frac{1}{0.1} = 10$rad/sec and $\omega_2 = \frac{1}{0.001} = 1000$ rad/sec

15. Which one of the following statements is **not** correct with respect to cascade lead compensator?

(a) The undamped natural frequency ω_n is increased considerably which reduces the settling time.
(b) It is used to improve the transient response of the given system
(c) It is used to improve the steady state performance of the given system
(d) The phase angle contribution to the root-loci is positive at the dominant pole position.

15. Ans: (c)

Sol: Lead is not used to improve the steady state performance.

16. For an n-channel silicon FET with a $=3\times10^{-4}$ cm and $N_D = 10^{15}$ electron/cm^3, what is the pinch-off voltage if the dielectric constant of silicon is $\varepsilon = 12\varepsilon_0$ and $\varepsilon_0 = \frac{1}{36\pi}\times10^{-9}$?

(a) 6.8 V (b) 5.2 V
(c) 8.8 V (d) 9.2 V

16. Ans: (a)

Sol: Given n-channel JFET

$N_D = 10^{15}/cm^3$

$\varepsilon_{si} = \varepsilon_0\,\varepsilon_r = 12\left[\frac{1}{36\pi}\times10^{-9}\right]$

As we know, pinch of voltage,

$|V_p| = \frac{qN_D a^2}{2\varepsilon}$,

where a is the half channel width and given $a = 3\times10^{-4}$ cm.

$\therefore |V_p| = \frac{1.6\times10^{-19}\times10^{15}\times[3\times10^{-4}]^2}{2\times12\times\left(\frac{1}{36\pi}\times10^{-9}\right)}$

$= \frac{1.44\times10^{-11}}{2.13\times10^{-12}} = 6.76$ V

17. What is the output votlage for an integrator when input is a step voltat for $0 \le t \le 2$, $R_1C_F = 3$ sec and $V_{in} = 6$ V?

(a) −4 V (b) −6 V
(c) −8 V (d) −10 V

17. Ans: (a)

Sol: Since for integrator, $V_0 = \frac{-1}{RC}\int_0^t V_i\,dt$

Given range, $0 \le t \le 2$

$\therefore V_0 = \frac{-1}{3}\int_0^2 6dt$

$= \frac{-1}{3}\times6[t]_0^2$

$= \frac{-1}{3}\times6\times2$

$= -4$ V

18. Consider the following statements related to Hall effect:
    1. Hall effect is used to determine whether a semiconductor is n-type or p-type.
    2. To find the carrier concentration.
    3. Measuring the conductivity (σ), the mobility, (μ) can be calculated.
    4. The hall effect has been incorporated into a magnetic field meter.

    Which of the above statements are correct?

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

18. Ans: (d)

Sol: Hall effect principle is used to determine
1. type of semiconductor
2. carrier concentration
3. conductivity and mobility of electron

Hall voltage is generated by perpendicular to the applied voltage and transverse magnetic field and hence hall effect is incorporated into the magnetic field meter.

19. The residue at the singular point z = –2 of $f(z) = \frac{1+z+z^2}{(z-1)^2(z+2)}$ is

    (a) $\frac{1}{2}$ (b) $\frac{1}{3}$
    (c) $\frac{4}{3}$ (d) $\frac{3}{2}$

19. Ans: (b)

Sol: Given $f(z) = \frac{1+z+z^2}{(z-1)^2(z+2)}$ and z = –2

Here, the given singular point z = – 2 is pole of order one of f(z).

Now, $R_1 = \text{Res}[f(z): z = z_0] = \underset{z\to z_0}{\text{Lt}}\left[(z-z_0).f(z)\right]$

$\Rightarrow R_1 = \underset{z\to -2}{\text{Lt}}\left[(z+2).\frac{1+z+z^2}{(z-1)^2(z+2)}\right]$

$\Rightarrow R_1 = \frac{1-2+(-2)^2}{(-2-1)^2}$

$\therefore R_1 = \frac{3}{9} = \frac{1}{3}$

20. The solution of the differential equation $\left(1+e^{\frac{x}{y}}\right)+e^{\frac{x}{y}}\left(1-\frac{x}{y}\right)\frac{dy}{dx} = 0$ is

    (a) $x + ye^{\frac{x}{y}} = C$ (b) $y + xe^{\frac{x}{y}} = C$
    (c) $1 + e^{\frac{x}{y}} = C$ (d) $-\frac{x}{y^2}e^{\frac{x}{y}} = C$

20. Ans: (a)

Sol: $\left(1+e^{\frac{x}{y}}\right)+e^{\frac{x}{y}}\left(1-\frac{x}{y}\right)\frac{dy}{dx} = 0$

$\left(1+e^{\frac{x}{y}}\right)dx + e^{\frac{x}{y}}\left(1-\frac{x}{y}\right)dy = 0$

$\frac{\partial M}{\partial y} = -\frac{xe^{\frac{x}{y}}}{y^2}$

$\frac{\partial N}{\partial x} = e^{\frac{x}{y}}\left(\frac{-1}{y}\right)+\left(1-\frac{x}{y}\right)e^{\frac{x}{y}}\left(\frac{1}{y}\right)$

$= \frac{-x}{y^2}e^{\frac{x}{y}}$

The given equation is exact.

$\left(x+ye^{\frac{x}{y}}\right) = C$

21. If a force $\vec{F} = 2x^2y\hat{i} + 3xy\hat{j}$ displaces a particle in the xy-plane from (0, 0) to (1, 4) along a curve $y = 4x^2$, what is the work done?

    (a) $\frac{102}{5}$ (b) $\frac{5}{104}$
    (c) $\frac{104}{5}$ (d) $\frac{5}{102}$

21. Ans: (c)

Sol: Work done (W.D) = $\int_c \overline{F}.d\overline{r}$

$\Rightarrow W.D = \int_{(0,0)}^{(1,4)} \left[(2x^2y)dx + (3xy)dy\right]$

ACE® Engineering Academy Leading Institute for ESE/GATE/PSUs Since 1995 x DEEP LEARN

EXCLUSIVE

ONLINE LIVE CLASSES

ENGLISH

CE | ME | EC | EE | CSIT

ESE | GATE | PSUs - 2022/2023

COURSE DETAILS

- For ESE+GATE+PSUs Students
  1. Online Live Classes - Technical Subjects Only.
  2. Recorded Classes - General Studies Subjects (on ACE Deep Learn Platform).
- Recorded version of the online live class will be made available through out the course (with 3 times view).
- Doubt clearing sessions and tests to be conducted regularly.
- 5 to 6 hours of live lectures per day in week days. On Sundays and Public Holidays 6-7 Hours of Live Online Lectures (6 days a week).
- Access the lectures from any where.

New Batch Start from:

24th JULY 2021

DISCOUNTS

- 25% OFF* for ACE Old Students
- 20% OFF* for IIT / NIT, Students
- 15% OFF* for IIIT & Govt. College students

APPSC / TSPSC - AEE (CE)
Batch Date: **19th July, 2021**

GENCO / TRANSCO / DISCOMs
Batch Date: **5th July, 2021**

SSC-JE (General Intelligence)
Batch Date: **2nd July, 2021**

Call: 040-23234418/19/20 | Email: hyderabad@aceenggacademy.com

Put $y = 4x^2$

$\Rightarrow dy = 8x\,dx$

Here: x varies from 0 to 1

$$\text{Now, W.D} = \int_{x=0}^{1}\left[(2x^2)(4x^2)dx + (3x)(4x^2)(8x)dx\right]$$

$$\Rightarrow \text{W.D} = \int_{x=0}^{1}\left[8x^4 + 96x^4\right]dx$$

$$\Rightarrow \text{W.D} = \left(\frac{8x^5}{5} + 96\frac{x^5}{5}\right)_0^1$$

$$\therefore\ \text{W.D} = \frac{8}{5} + \frac{96}{5} = \frac{104}{5}$$

22. A die is tossed thrice. A success is getting 1 or 6 on a toss. Then, mean and variance of the number of successes are

(a) Mean = $\frac{1}{2}$, Variance = $\frac{3}{2}$

(b) Mean = 1, Variance = $\frac{2}{3}$

(c) Mean = $\frac{1}{2}$, Variance = $\frac{2}{3}$

(d) Mean = 1, Variance = $\frac{1}{2}$

22. Ans: (b)

Sol: Nubmer of tosses = 3

P = P (occurance of 1 or 6)

$= \frac{1}{6} + \frac{1}{6}$

$P = \frac{1}{3}, q = \frac{2}{3}$

mean = np = $(3)\left(\frac{1}{3}\right) = 1$

Variance = npq = $(3)\left(\frac{1}{3}\right)\left(\frac{2}{3}\right) = \frac{2}{3}$

23. In which matrix are eigen vectors corresponding to different eigen values orthogonal?

(a) singular matrix

(b) Non-singular matrix

(c) Symmetric matrix

(d) Non-symmetric matrix

23. Ans: (c)

Sol: The eigen vectors corresponding to distinct eigen values of a real symmetric matrix are always othagonal.

24. '0' is a characteristic root of a matrix, if and only if, the matrix is

(a) Idempotent matrix (b) Perodic matrix

(c) Nilpotent matrix (d) Singular matrix

24. Ans: (d)

Sol: If an eigen value $\lambda = 0$ then

det(A) = product of eigen values

$\Rightarrow$ det(A) = 0

$\therefore$ A is a singular matrix

25. The value of $\int_0^{\frac{\pi}{6}} \cos^4 3\theta \sin^3 6\theta d\theta$ is

(a) $\frac{1}{15}$ (b) $\frac{8}{3}$

(c) $\frac{7}{3}$ (d) $\frac{7}{15}$

25. Ans: (a)

Sol: $\int_0^{\pi/6} \cos^4 3\theta \sin^3 6\theta d\theta$

Let $3\theta = t$

$3d\theta = dt$

$d\theta = \frac{dt}{3}$

limits of t are 0 to $\pi/2$

$$\int_0^{\pi/2} \cos^4 t \sin^3 2t \frac{dt}{3}$$

$$\frac{1}{3}\int_0^{\pi/2} \cos^4 t\, 8 \sin^3 t \cos^3 t\, dt$$

$$\left(\frac{4}{3}\right)(2)\int_0^{\pi/2} \sin^3 t \cos^7 t dt$$

$$= \frac{8}{3}\left[\frac{(6\times 4\times 2)(2)}{10\times 8\times 6\times 4\times 2}\right] = \frac{1}{15}$$

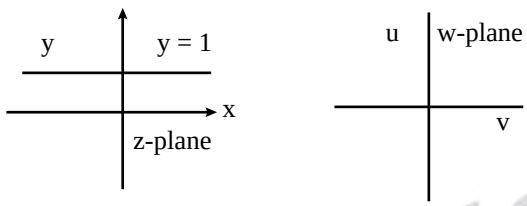
26. The image of the line $I_m(z) = 1$ under the mapping $w = z^2$ is

(a) $u^2 = 4(v + 1)$ (b) $v^2 = 4(u + 1)$

(c) $u = 4(v + 1)$ (d) $v = 4(u + 1)$

26. Ans: (b)

Sol:



Given that $I_m(z) = 1$, where $z = x + iy$

$\Rightarrow y = 1$

Consider

$w = z^2 = x^2 - y^2 + i2xy = u + iv$

where $u = x^2 - y^2$, $v = 2xy$

for $y = 1$, we have $u = x^2 - 1$, $v = 2x$

$v^2 = 4x^2$

$= 4(x^2 - 1 + 1)$

$= 4u + 4$

$v^2 = 4(u+1)$

27. The number of emergency admissions each day to a hospital is found to have Poisson's distribution with mean 4. What is the probability that on a particular day there will be no emergency admissions?

(a) e^{-4} (b) e^{-2}

(c) e^2 (d) e^4

27. Ans: (a)

Sol: Let X represent number of emergency admission's each day to a hospital. Given X is poisson random variable with mean

$4 \Rightarrow \lambda = 4$

$$P(X = 0) = \frac{e^{-\lambda}\lambda^0}{0!} = e^{-4}$$

28. How many seconds would a clock lose per day if the length of its pendulum was increased in the ratio of 900 : 901?

(a) 48 (b) 25

(c) 16 (d) 56

28. Ans: (a)

Sol: Let 'ℓ' be the original length

$d\ell$ be the increase in it

$$\therefore \frac{\ell + d\ell}{(\ell)} = \frac{901}{900}$$

$$\Rightarrow \frac{d\ell}{\ell} = \frac{1}{900}$$

Let n = number of beats (or seconds) per day

$= 24 \times 60 \times 60$

$= 86400$

Let dn denote the change in the no. of beats.

Then, $dn = -\left(\frac{n}{2}\right)\frac{d\ell}{\ell}$

$$= -\frac{86400}{2} \times \frac{1}{900}$$

$= -48$

Hence the no.of seconds lost by the clock per day = 48.

29. In estimating the cost of a pile of bricks measured as $2m \times 15m \times 1.2m$, the tape is stretched 1% beyond the standard length. If the count is 450 bricks to 1 cu.m and bricks cost Rs. 530 per 1000, what is the approximate error in the cost?

(a) Rs. 257.58 (b) Rs. 152.65

(c) Rs. 345.41 (d) Rs. 329.49

29. Ans:(a)

Sol: Volume of cuboid (Pie of bricks)

$V = L \times B \times h$

$$\% \text{ of error in length} = \frac{dL}{L} \times 100 = 1\%$$

$$\% \text{ of error in breadth} = \frac{dB}{B} \times 100 = 1\%$$

$$\% \text{ of error in height} = \frac{dH}{H} \times 100 = 1\%$$

$V = L \times B \times H$

Take logorithm on both sides

$\log V = \log L + \log B + \log H$

$$\frac{1}{V}dV = \frac{1}{L}dL + \frac{1}{B}dB + \frac{1}{H}dH$$

$$\frac{dV}{V}\times 100 = \frac{dL}{L}\times 100 + \frac{dB}{B}\times 100 + \frac{dH}{H}\times 100$$

$$= 1 + 1 + 1$$

$$= 3\%$$

$$dV = \frac{3\times V}{100} = \frac{3\times 2\times 15\times 1.2}{100} = 1.08$$

Volume increased = 1.08 cu.m

No. of bricks in 1 cubic meter = 450

$\therefore$ No. of bricks in 1.08 cubic meter = 450×1.08

$= 486$

$$\therefore \text{Loss for bricks seller} = \frac{530}{1000}\times 486 = 257.58 \text{ Rs}$$

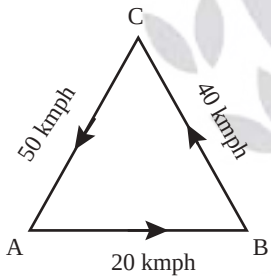
30. Three cities A, B, C are equidistant from each other. One motorist travels from A to B at 20 km/hr, from B to C at 40 km/hr, from C to A at 50 km/hr. What is the average speed?

(a) 38.3 km (b) 31.6 km

(c) 39.2 km (d) 34.6 km

30. Ans: (b)

Sol:



Given AB = BC = CA = D

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{D+D+D}{\frac{D}{20}+\frac{D}{40}+\frac{D}{50}}$$

$$\text{Average speed} = \frac{3D}{D\times\left(\frac{10+5+4}{200}\right)}$$

$$= \frac{600}{19} = 31.579 \text{ kmph}$$

31. Which one of the following instruments is the most sensitive of the moving iron mechanism and has the most linear scale?

(a) Moving coil

(b) Hot wire

(c) Electrodynamometer

(d) Radial vane repulsion

31. Ans:(d)

Sol: If the vanes are radial, then it is called radial vane repulsion type instrument.

It consists of two iron strips (vanes) are placed radially, in which one is fixed and the other is movable. In this type of instrument, the deflection torque is directly proportional to the actual current in the coil, thus making the scale uniform and readings can be obtained directly. These are the most sensitive type of instruments.

32. A voltmeter has a resistance of 300 Ω and inductance of 0.12 H. This instrument reads correctly on DC. What is the reading on AC at 100 V when the frequency is 25 Hz?

(a) 99.80 V (b) 120.36 V

(c) 142.00 V (d) 151.00 V

32. Ans: (a)

Sol: $R_m = 300\ \Omega$; $L_m = 0.12$ H

AC voltage = 100V, f = 25 Hz

$$\text{on DC: } I = \frac{V}{R} = \frac{100}{300} = 0.333$$

$$\text{On AC: } I = \frac{V}{Z}$$

$$= \frac{V}{0.33\left[\sqrt{(300)^2 + (2\times\pi\times 25\times 0.12)^2}\right]}$$

$$= 0.33267 \text{ A}$$

For, $0.333 \text{ A} \rightarrow 100 \text{ V}$

$0.33267 \text{ A} \rightarrow ?$

$$\therefore \text{Voltmeter reading} = \frac{0.33267\times 100}{0.333}$$

$$= 99.80 \text{ V}$$

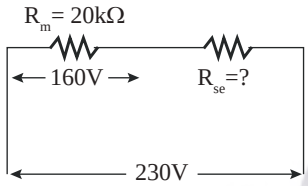
33. A voltmeter has a resistance of 20 kΩ and connected in series with an external resistance across a 230 V supply. If the instrument reads 160V, then the value of external resistance is

(a) 6744 Ω (b) 7748 Ω

(c) 8750 Ω (d) 9752 Ω

33. Ans: (c)

Sol:



$$160 = 230 \times \frac{20k}{20k + R_{se}}$$

$$\frac{160}{230} = \frac{20k}{20k + R_{se}}$$

$$R_{se} = 8750\ \Omega$$

34. A moving coil instrument gives full-scale deflection with 15 mA and has a resistance of 5 Ω. The value of resitance to be connected in series to enable it to read up to 100V is

(a) 6666.66 Ω (b) 6660.66 Ω

(c) 6661.60 Ω (d) 6662.60 Ω

34. Ans: (c)

Sol: $I_{FSD} = I_m = 15$ mA; $R_m = 5\ \Omega$

V= 100 V; R_{se} = ?

$$V_m = I_m R_m$$

$$= 15 \times 10^{-3} \times 5$$

$$= 75 \text{ mV}$$

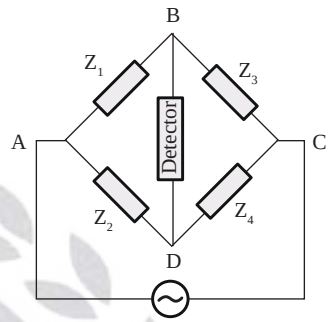
$$R_{se} = R_m\left(\frac{V}{V_m} - 1\right)$$

$$= 5\left(\frac{100}{75 \times 10^{-3}} - 1\right)$$

$$= 6661.667\ \Omega$$

35. The impedance of an AC bridge as shown in figure below are as follows:

$Z_1 = 100\ \Omega$ with phase angle of 60°, $Z_2 = 300\Omega$ with a phase angle of 0° and $Z_3 = 50\Omega$ with phase angle of 30°. What is the nature of unknown impedance Z_4?



(a) Purely resistive circuit

(b) Series R-C circuit

(c) Series R-L circuit

(d) Parallel R-L circuit

35. Ans: (b)

Sol: $Z_1 Z_4 = Z_2 Z_3$

$$Z_4 = \frac{(300\angle 0^\circ)50\angle 30^\circ}{100\angle 60^\circ}$$

$$= 150\angle -30^\circ$$

As the impedance angle is negative, the branch is R-C series circuit

36. Consider the measuring system consisting of a sensor, an amplifier and an oscilloscope. The sensitivity of each equipment is as follows: Sensor sensitivity: 0.4 mV/°C. Amplifier gain: 5.0 V/mV, and oscilloscope sensitivity: 10 mV/V. What is the sensitivity of complete measurment system?

(a) 5.0 V/mV (b) 10 mV/V

(c) 15.4 mV/°C (d) 20 mV/°C

36. Ans: (d)

Sol: Sensitivity of complete system is

= 0.4 mV/ °C × 5 V/mV × 10 mV/V

= 20 mV/ °C

37. A moving coil meter 50 Ω resistance reads up to 25 mA. What is the value of series resistance, so that it can be read up to 10 V?
(a) 300 Ω (b) 250 Ω
(c) 350 Ω (d) 400 Ω

37. Ans: (c)

Sol: $R_m = 50\ \Omega$; $I_m = 25$ mA
$V = 10$ V; $R_{se} = ?$
$V_m = I_m R_m = 25\text{mA} \times 50\ \Omega = 1.25$ V

$$R_{se} = R_m\left(\frac{V}{V_m} - 1\right)$$

$$= 50\left(\frac{10}{1.25} - 1\right) = 350\ \Omega$$

38. Which one of the following analog to digital conversion methods is called potentiometric type analog to digital converter?
(a) Successive approximation method
(b) Voltage to time conversion method
(c) Voltage to frequency conversion method
(d) Dual slope integration method

38. Ans: (a)

Sol: Successive approximation method is called as potentiometric type analog to digital converter.

39. A piezoelectric transducer has a capacitance of 1500 pF and leakage resistance of 10^5 MΩ. the oscillatoscope used for read-out has a resistance of 1 MΩ in parallel with a capacitance of 500 pF. What is the time constant of the entire system?
(a) 0.002 s (b) 0.20 s
(c) 20 s (d) 200 s

39. Ans: (a)

Sol: Equivalent resitance is

$$R_{eq} = \frac{10^5 \times 10^6 \times 10^6}{(10^5 \times 10^6) + 10^6} = 999990\ \Omega$$

$C_{eq} = 1500 \times 10^{-12} + 500 \times 10^{-12}$
$= 2000$ pF
Time constant $= R_{eq} C_{eq} = 0.002$ sec

40. Consider the following regarding the drawbacks of BCD arithmetic over binary arithmetic:
1. Perform arithmetic operations indirectly on decimal data
2. Take more time for execution.
3. Less efficient use of memory.
4. Small number of computations are required.

Which of the above drawbacks are correct ?
(a) 1 and 4 only
(b) 2 and 3 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

40. Ans: (b)

Sol: BCD arithmetic takes longer time for execution for checking the auxiliary flag and its memory use of efficiency is less

41. Which one of the following registers holds the data on which the system has to operate, intermediate results and results of operations performed?
(a) Program control register
(b) Accumulator register
(c) Instruction register
(d) Input/output register

41. Ans: (b)

Sol: Accumulator Register is used to hold the result of the Arithmetical operations

42. Which one of the following is **not** a general operation of machine cycle in a central processing unit?
(a) Fetch (b) Decode
(c) Return (d) Store

42. Ans: (c)

Sol: Return is not a general machine cycle in instruction cycle

43. Consider the following statements in order to perform a write operation into a specified memory location, the MDR and MAR:
    1. The word to be stored into the memory location is first loaded by the CPU into MDR
    2. The address of the location into which the word is to be stored is loaded by the CPU into MAR
    3. A write signal is issued by the CPU

    Which of the above statements are correct?
    (a) 1 and 2 only (b) 1 and 3 only
    (c) 2 and 3 only (d) 1, 2 and 3

43. Ans: (d)

Sol: During writing operation, the CPU performs below operations
MDR ← Data
MAR ← Address
Control unit generates MWR signal

44. In which one of the following modes does the DMA controller keep control of the bus until all the data has been transferred to (from) memory from (to) the peripheral device?
    (a) Burst mode (b) Transfer mode
    (c) Mice mode (d) Addressing mode

44. Ans: (a)

Sol: Only in burst mode the CPU will be in waiting mode until completion of the DMA data transfer operation between secondary memory and main memory.

45. Which one of the following addressing modes leads to poor programing practice?
    (a) Direct addressing mode
    (b) Indirect addressing mode
    (c) Immediate addressing mode
    (d) Implied addressing mode

45. Ans: (b)

Sol: Indirect addressing mode instruction requires more number of memory visits during execution cycle.

46. A point charage of 10^{-9} C is placed at a point A in free space. What is the intensity of electrostatic field on the surface of a sphere of radius 5 cm at centre A?
    (Take $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ in SI units)
    (a) 1800 V/m (b) 3600 V/m
    (c) 5360 V/m (d) 2820 V/m

46. Ans: (b)

Sol: Electric field intensity at any point on the surface of the sphere is given by

$$E = \frac{Q}{4\pi\varepsilon_0 r^2}$$

Given: $Q = 10^{-9}$ C
$r = 5\times 10^{-2}$ m

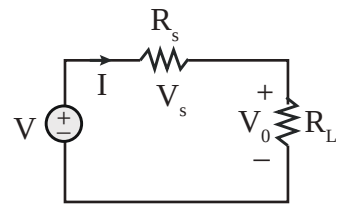
$$E = \frac{9 \times 10^9 \times 10^{-9}}{(5 \times 10^{-2})^2}$$

$E = 3600$ V/m

47. A generator develops 250V and has an internal resistance of 100 Ω. If the load resistance is 100Ω, then what is the efficiency of the generator?
    (a) 80% (b) 50%
    (c) 60% (d) 70%

47. Ans: (b)

Sol:



$$I = \frac{V}{R_s + R_L}$$

Power in the R_L is $= I^2 R_L = \left[\frac{V}{R_s + R_L}\right]^2 R_L$

For maximum power transfer

$$\frac{dP}{dR_L} = 0, V^2\left[\frac{(R_s+R_L)^2 - 2(R_s+R_L)R_L}{(R_s+R_L)}\right] = 0$$

$$R_s = R_L$$

$$I = \frac{V}{2R_L}, P_{max} = \frac{V^2}{4R_L}$$

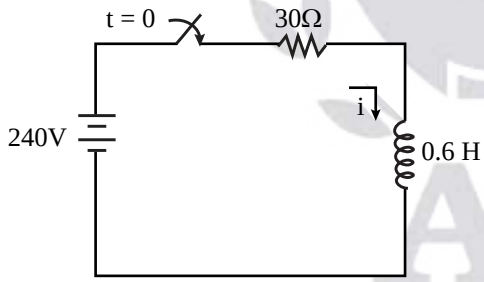
$$\eta = \frac{\text{output}}{\text{input}} = \frac{V^2\,4R}{V\left(\frac{V}{2R_L}\right)} \times 100$$

$$\frac{\frac{V}{2}\times 100}{V} = 50\%$$

48. A coil resistance 30 Ω and inductance 0.6 H is switched on to a 240 V supply. What are the rate of change of current at the instant of closing the switch at t = 0 and the magnitude of the final steady state current respectively?
(a) 80 A/sec and 80 A
(b) 400 A/sec and 8 A
(c) 8 A/sec and 80 A
(d) 400 A/sec and 80 A

48. Ans: (b)

Sol:



$$i(\infty) = \frac{240}{30} = 8A, \quad i(0^-) = i(0^+) = 0$$

$$-240 + 30i + 0.6\frac{di}{dt} = 0$$

at $t = 0^+$

$$-240 + 30(0) + 0.6\frac{di(0^+)}{dt} = 0$$

$$\frac{di(0^+)}{dt} = \frac{+240}{0.6}$$

$$= 400 \text{ A/sec}$$

49. A current of 10A flows in a circuit with a 30° angle of lag when the applied voltage is 100 V. What are the values of resistance and reactance in the circuit respectively?
(a) 8.66 Ω and 5 Ω
(b) 5 Ω and 8.66 Ω
(c) 6.66 Ω nd 4 Ω
(d) 4 Ω and 6.66 Ω

49. Ans: (a)

Sol: $\overline{V} = 100 \angle 0^\circ$

$\overline{I} = 10 \angle -30^\circ$

$$Z = \frac{V}{I} = \frac{100\angle 0^\circ}{10\angle -30^\circ} = 10\angle +30^\circ$$

$$= 8.66 + j5\ \Omega$$

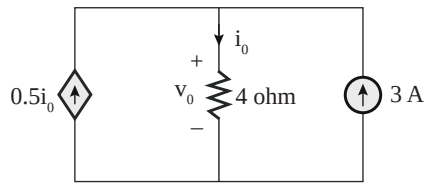
$R = 8.66\ \Omega$ and $X_L = 5\ \Omega$

50. Consider the following statements regarding reciprocity theorem:
1. In any passive linear bilataral network, if the single voltage source V_x in branch x produces the current response I_y in branch y, thent he removal of the voltage source from brnach x and its insertion in branch y will produce the current response I_y in branch x.
2. The interchange of an ideal voltage soruce and an ideal ammeter in any passive, linear, bilateral circuit will not change the ammeter reading.
3. The interchange of an ideal current source and an ideal voltmeter in any passive linear bilateral circuit will change the voltmeter reading.

Which of the above statements are correct?
(a) 1 and 3 only
(b)1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

50. Ans: (b)

51. What is the value of v_0 in the given circuit?



(a) 12 V (b) 6V
(c) 24 V (d) 15 V

51. Ans: (c)

Sol: Nodal

$$-\frac{i_0}{2}+\frac{V_0}{4}-3=0$$

$$2i_0+V_0=12 \quad \text{..... (1)}$$

$$i_0=\frac{V_0}{4} \quad \text{..... (2)}$$

$$-2\left[\frac{V_0}{4}\right]+V_0=12$$

$$\frac{V_0}{2}=12 \rightarrow V_0=24$$

52. A network has 8 branches and 4 independent loops. How many nodes are there in the network?
(a) 11 (b) 13
(c) 5 (d) 3

52. Ans: (c)

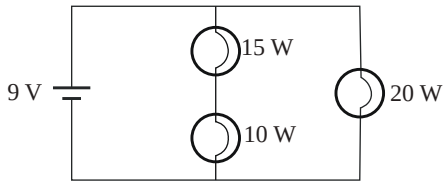
Sol: b = 8 , m = 4

$m = b - n + 1$

$4 = 8 - n + 1$

$n = 5$

53. There light bulbs are connected to a 9 V battery as shown in the figure. What are the values of the resistance of 20W, 15 W, 10 W bulbs respectively?

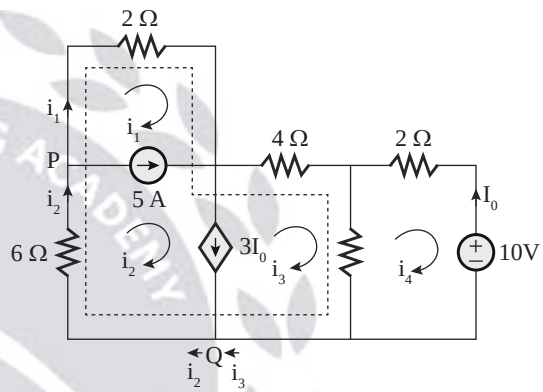


(a) 4.05 Ω, 1.945 Ω, 1.297 Ω
(b) 6.02 Ω, 3.726 Ω, 3.162 Ω
(c) 7.672 Ω, 4.887 Ω, 4.223 Ω
(d) 8.345 Ω, 6.893 Ω, 5.634 Ω

53. Ans: (a)

Sol: For 20 W bulb, $R_1=\frac{V^2}{P_1}=\frac{9^2}{20}=4.05\ \Omega$

54. For the circuit in figure, the values of i_1 and i_4 are respectively,



(a) –7.5 A, 2.143 A (b) –2.5 A, 3.93 A
(c) 3.4 A, –6.5 A (d) 7.1 A, –3.5 A

54. Ans: (a)

Sol: $2i_1 + 4i_3 + 8[i_3 - i_4] + 6i_2 = 0$

$i_1 + 3i_2 + 6i_3 - 4i_4 = 0$ ..... (1)

$-i_1 + i_2 = 5$ ..... (2)

$i_2 - i_3 = 3I_0$ ..... (3)

$4[i_4 - i_3] + 2i_4 + 10 = 0$

$-4i_3 + 5i_4 = -5$ ..... (4)

$i_4 = -I_0$ ..... (5)

solve

$$\left.\begin{aligned} i_1+3i_2+6i_3-4i_4&=0\\ -i_1+i_2&=5\end{aligned}\right]$$

$$\begin{aligned} 4i_2+6i_3-4i_4&=5\\ 4i_2-4i_3+12i_4&=0\\ \hline 10i_3-16i_4&=5\end{aligned}$$

$$\left.\begin{aligned} i_2-i_3+3i_4&=0\\ -4i_3+5i_4&=-5\end{aligned}\right]$$

$$\begin{aligned} 40i_3-64i_4&=20\\ -40i_3+50i_4&=-50\\ \hline -14i_4&=-30\end{aligned}$$

$\rightarrow i_4 = 2.14$

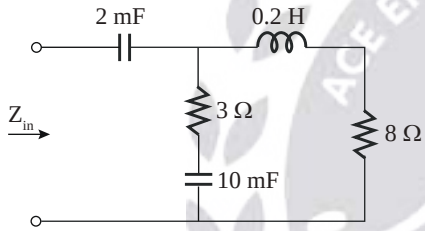
& $i_1 = -7.5$ A

55. An energy source forces a constant current of 2 A for 10 s to flow through a light bulb. If 2.3 kJ is given off in the form of light and heat energy, what is the voltage drop across the bulb?
(a) 120 V (b) 115 V
(c) 110 V (d) 105 V

55. **Ans:(b)**

Sol: I = 2A, t = 10 sec, E = 2.3 KJ
E = V.I.t
2300 = V.(2) (10)
V = 115 V

56. What is the input impedance of the circuit, if the circuit operates at ω = 50 rad/s?



(a) (5.63 – j8.94) Ω (b) (3.22 – j11.07) Ω
(c) 4.54 + j6.79) Ω (d) (6.86 + j13.54) Ω

56. Ans: (b)

Sol: $X_{c1} = \frac{-j}{(50)(2\times10^{-3})} = \frac{-j}{10^{-1}} = -j10\Omega$

$X_{c2} = \frac{-j}{(50)(10\times10^{-3})} = -j2\Omega$

$X_{c1} = +j(50)(0.2) = +10\Omega$

$Z_{in} = -j10 + [(3 - j2]// [8+j10]$

$= -j10 + 3.22 - j1.07$

$= (3.22 - j11.07)\ \Omega$

57. A three phase motor can be regarded as a balanced Y-load. A three phase motor draws 5.6 kW, when the line voltage is 220 V and the line current is 18.2 A. What is the power factor of the motor?
(a) 0.8075 (b) 0.6134
(c) 0.9593 (d) 0.7947

57. Ans: (a)

Sol: $P_T = \sqrt{3}\,V_L I_L \cos\phi$

$5600 = \sqrt{3}(220)(18.2)\cos\phi$

$\cos\phi = \frac{5600}{\sqrt{3}(220)(18.2)} = 0.8075$

58. A 0 - 150 V voltmeter has a guaranteed accuracy of 1% of full scale reading. the voltage measured by this instrument is 75 V. What is the percentage of limiting error?
(a) 1% (b) 2%
(c) 3% (d) 4%

58. Ans: (b)

Sol: FSV = 150 V
GAE = ±1 %
A_t = 75 V

$\%L.E = \frac{150}{75}\times\pm\,1\% = \pm2\%$

59. What is the value of shunt resistance of an ammeter, if the range is extended from 1 mA to 10 mA and meter has a resistance of 27 Ω?
(a) 3 Ω (b) 4 Ω
(c) 2.5 Ω (d) 3.5 Ω

59. Ans: (a)

Sol: I_m = 1 mA; I = 10 mA
R_m = 27 Ω; R_{sh} = ?

$R_{sh} = \frac{R_m}{\frac{I}{I_m} - 1} = \frac{27}{\left(\frac{10m}{1m} - 1\right)} = 3\ \Omega$

60. In a dynamometer type wattmeter at low power factor, the inductance of the pressure coil introduces a serious error. This error can be minimized by
(a) connecting a high resitance in series with it and connected a capacitor across a part of this resistance
(b) connecting a high resistance in parallel with it and connecting a capacitor across a part of this resistance.

ACE Engineering Academy
Leading Institute for ESE/GATE/PSUs
Since 1995
x DEEP LEARN

HIGHLIGHTS

- Detailed Solutions are Available.
- Video Solutions are Available for Difficult Questions.
- All India rank will be given for each test.
- Comparison with all India toppers of ACE student.

TEST WISE STATISTICS:

QUESTION WISE STATISTICS:

(c) connecting a low resistance in series with it and connecting a capacitor across a part of this resistance.

(d) connecting a low resistance in parallel with it and connecting a capacitor across a part of this reistance.

60. Ans: (a)

Sol: By connecting a high resistance in series with PC and connecting a capacitor across a part of this resistance.

61. Consider the following statements for a simple assembler:

1. It scans the entire assemble program twice, where each scan is called a pass.
2. It generates a table that includes all symbols and their binary values
3. It will use the symbol table and other tables to generate the object program and output some information that will be needed by the linker

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3

Ans: (d)

62. Daisy-chaining method is used for

(a) establishing priority.

(b) data transfer.

(c) initiating input and output.

(d) direct memory access

62. Ans: (a)

Sol: Daisy chain method is used for providing the interrupt priority when 2 or more devices request the CPU at a time.

63. The performance of cache memory is measured in terms of

(a) Read ratio (b) Reference ratio

(c) Hit ratio (d) Locality ratio

63. Ans: (c)

Sol: In all systems, the cache memory performance is measured in terms of Hit ratio.

64. According to the Belady's anomaly, the page-fault rate may

(a) increase as the number of allocated frames increases.

(b) increase as the number of allocated frames decreases.

(c) not change as the number of allocated frames increases

(d) not change as the number of allocated frames decreases

64. Ans: (a)

Sol: In general, when the number of page frames in memory are increased, then the number of page faults must be decreased.

Belady's anomaly: According to the Belady's anomaly, the page-fault rate may increase as the number of allocated frames increases.

Belady's anomaly may occur in FIFO & Random Page Replacement Algorithms.

65. What is the maximum bit rate of a noiseless channel with a bandwidth of 1000 Hz transmitting a signal with two signal levels?

(a) 2000 bps (b) 3000 bps

(c) 4000 bps (d) 6000 bps

65. Ans: (a)

Sol: Channel capacity of a noiseless channel = $C = 2B\log_2\mu$

$B = 1000$

$\mu = 2$

$C = 2 \times 100\log_2 2$

$= 2000$ bps

66. A signal has eight data levels with a pulse duration of 1 ms. What is the bit rate?
(a) 1000 bps (b) 2000 bps
(c) 3000 bps (d) 4000 bps

66. Ans: (c)

Sol: L = 8 T = 1 ms

$= 2^n$

$T_b = \frac{T_S}{3} = 0.33\text{ ms}$

$R_b = \frac{1}{T_b} = \frac{1}{0.33 \times 10^{-3}}$

= 3 kbps

= 3000 bps

67. In a CB configuration, the current amplification factor is 0.97. If the emitter current is 1 mA, the value of base current is
(a) 0.97 mA (b) 1.0 mA
(c) 0.03 mA (d) 1.03 mA

67. Ans: (c)

Sol: Given common base BJT $\rightarrow \alpha_F = 0.97$

$I_{EQ} = 1$ mA

As we know, $\alpha_F = \frac{I_{CQ}}{I_{EQ}}$

$\Rightarrow I_{CQ} = 0.97 \times 1m$

= 0.97 mA

As $I_{BQ} = I_{EQ} - I_{CQ}$

=1m – 0.97 = 0.03mA

68. The power amplifier in which the operating point is so adjusted that the collector current flows only during the positive half-cycle of the input signal are known as
(a) Class-B amplifiers.
(b) Class A amplifiers
(c) Class-AB amplifiers
(d) Class-C amplifiers

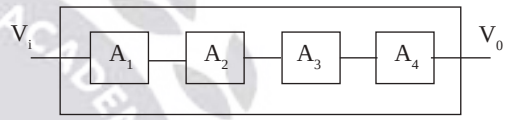
68. Ans: (a)

Sol: If Q point is selected at cut off region, then transistor conducts only for 180° of input. Such that at output the conduction angle is 180° indicates class B power amplifier.

69. A multistage amplifier employs four stages, each of which has a voltage gain of 40. The overall gain of the amplifier is approximately
(a) 32 dB (b) 64 dB
(c) 96 dB (d) 128 dB

69. Ans: (d)

Sol:



Over all gain [A]

Since $A = A_1A_2A_3A_4 = 40 \times 40 \times 40 \times 40 = 2,56,0000$

In decibles $\rightarrow [A]_{dB} = 20\log_{10}|A| = 128.16$ dB

$\therefore |A|_{dB} = 128$ dB

70. Consider the following statements regarding R-C coupled amplifiers:
1. The cost of R-C coupled amplifier is low because of low cost of coupling capacitors and resistors
2. They occupy less space because of small size of resistors and capacitors.
3. They have better frequency response.

whcih of the above statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1, 2 and 3 (d) 1 and 3 only

Ans: (c)

Sol: 1. The cost of coupling elements (resistors & cpacitors) is low when compared with transformers and inductors
2. Capacitors and resistors occupy less space when compared with transformers and inductors.

TSPSC

ASSISTANT EXECUTIVE ENGINEERS

ACE® Engineering Academy Since 1995 Leading Institute for ESE/GATE/PSUs x DEEP LEARN

ONLINE TEST SERIES

Starts from:
26th JULY
2021

No. of Tests: 30
Subject wise : **22**
Full Length Mock Tests : **8**

ACE® Engineering Academy Since 1995 Leading Institute for ESE/GATE/PSUs x DEEP LEARN

ESE - 2021 MAINS TEST SERIES

No. of Tests: 10
(Subject wise:6, Mock Tests: 4)

Free for all ESE 2021 Prelims Qualified Students

Commencing from
28th August, 2021

All Tests will be conducted in **QCAB format**

Call: 040-48539866 / 40136222
Email: testseries@aceenggacademy.com

3. The frequency response of RC coupled amplifier is better when compared with transformer couple and inductor couple amplifiers.

71. For depletion type MOSFET:I_D =4.5 mA at V_{GS} = –2V. What is the value of I_{DSS} if V_P = –5 V?
(a) 5.5 mA (b) 12.5 mA
(c) 5.0 mA (d) 15 mA

71. Ans: (b)

Sol: Given I_{DQ} = 4.5 mA
V_{GSQ} = –2 V,
$(V_{GS})_{off}$ = –5 V
I_{DSS} = ?
For deflection type, in saturation region

$$I_D = I_{DSS}\left[1 - \frac{V_{GS}}{(V_{GS})_{off}}\right]^2$$

$4.5\ m = I_{DSS}[1 - 0.4]^2$
I_{DSS}= 12.5 mA

72. Which one of the following consists of a layer of metal at the tip named gate, a silicon dioxide layer below it, and a semiconductor substrate as the bottom-most layer?
(a) JFET (b) BJT
(c) MOSFET (d) DMOSFET

Ans: (c & d)

Sol:

MOSFET	DMOSFET
M → Metal (Gate)	D → Depletion
O → Oxide (SiO_2)	M → Metal (Gate)
S→ Semiconductor (Substrate)	O → Oxide
	S → Semiconductor
F → Field	F → Field
E → Effect	E → Effect
T → Transistor	T → Transistor

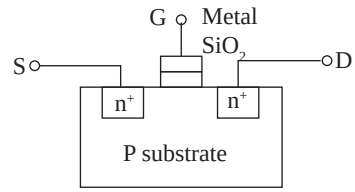


Fig: Structure of MOSFET

73. In a common base configuration, the alpha of the transistor is 0.99, it callector current is 1 mA and the collector to base current with emitter open is 1 μA. The value of base current is
(a) 29 μA (b) 19 μA
(c) 9 μA (d) 39 μA

73. Ans: (c)

Sol: Given common base, α_F = 0.99
I_{CQ} = 1 mA
I_{CB0}= 1 μA
Since we know, $I_{CQ} = \alpha_F I_E + I_{CB0}$
$\Rightarrow 1m = 0.99\ I_{EQ} + 1\mu$
$\therefore$ **I_{EQ} = 1.009 mA**
As $I_{BQ} = I_{EQ} - I_{CQ}$ = 1.009 m – 1 mA = 9 μA

74. The MOSFET is in the cut-off state, when the gate source voltage is
(a) less than gate to source voltage
(b) greater than gate to source voltage
(c) less than the threshold voltage
(d) greater than the threshold voltage

74. Ans: (c)

Sol: If $V_{GS} < V_{Th}$, i.e., if Gate to source voltage is less than threshold voltage $\Rightarrow$ MOSFET is OFF.
i.e., it is in cut off state.

75. For an ideal supply, the output voltage is independent of the load and the percentage regulation is
(a) equal to zero
(b) equal to unity
(c) greater than unity
(d) less than unity but not zero.

75. Ans: (a)

Sol: $\%\text{Regulation} = \dfrac{V_{\text{No load}} - V_{\text{full load}}}{V_{\text{Full load}}} \times 100\%$

If the output voltage is independent of the load, no load voltage and full load voltage both are equal.

i.e., $V_{\text{No load}} = V_{\text{Full load}}$

$\therefore$ % Regulation = 0%

76. Which one of the following filters is used for reduction of power line harmonics, suppression of clutter from fixed objects in moving target indication radar?

(a) NOTCH filter (b) IIR filter

(c) FIR filter (d) COMB filter

76. Ans:(d)

Sol: COMB filter is the simplest form of a notch filter in which the nulls occur periodically across the frequency band. These filters are used for reduction of power line harmonics, suppression of clutter from fixed objects in Moving Target Indication (MTI) radar.

77. For $Z_1 = 2e^{j\pi/4}$ and $Z_2 = 8e^{j\pi/3}$, the value of $\dfrac{Z_1}{Z_2^2}$ is

(a) $e^{-j\frac{5\pi}{12}}$ (b) $\frac{1}{8}e^{-j\frac{6\pi}{17}}$

(c) $\frac{1}{32}e^{-j\frac{5\pi}{12}}$ (d) $\frac{1}{14}e^{-j\frac{5\pi}{17}}$

77. Ans: (c)

Sol: $Z_1 = 2e^{j\pi/4}$, $Z_2 = 8e^{j\pi/3}$

$$\frac{Z_1}{Z_2^2} = \frac{2e^{j\pi/4}}{(64)e^{j2\pi/3}} = \frac{1}{32}e^{j\left(\frac{\pi}{4}-\frac{2\pi}{3}\right)} = \frac{1}{32}e^{-j\frac{5\pi}{12}}$$

78. The simplified value of $\int x^2 \cos ax\, dx$ is

(a) $\frac{1}{a^3}(2ax\cos ax - 2\sin ax + a^2x^2\sin ax)$

(b) $\frac{1}{a^2}(2ax\cos ax - 2\sin ax + a^2x\sin ax)$

(c) $\frac{1}{a}(2ax\cos ax - 2\sin ax + ax\sin ax)$

(d) $\frac{1}{a}(2ax\cos ax - 2\sin ax + a^2x^2\sin ax)$

78. Ans: (a)

Sol: $\int x^2\cos(ax)dx$

$$= x^2\frac{\sin(ax)}{a} - (2x)\left[\frac{-\cos(ax)}{a^2}\right] + (2)\left[\frac{-\sin(ax)}{a^3}\right]$$

$$= \frac{1}{a^3}[a^2x^2\sin(ax) + (2ax)\cos(ax) - 2\sin(ax)]$$

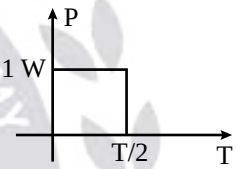
79. What is the total average power in the unit-amplitude square wave of period, T, and 50% duty cycle?

(a) 1.5 (b) 0.25

(c) 0.5 (d) 1

79. Ans: (c)

Sol:



Duty ratio $D = \dfrac{T_{ON}}{T} = \dfrac{T/2}{T} = 0.5$

$P_{\text{average}} = DP_m = 0.5 \times 1 = 0.5$ W

80. For a system with unit impulse response $h[k] = (0.5)^k u[k]$, what is the zero state response $y[k]$ for the input $f[k] = (0.8)^k u[k]$

(a) $y[k] = \left[-\frac{2}{3}(0.5)^k + \frac{7}{3}(0.6)^k\right]u[k]$

(b) $y[k] = \left[-\frac{5}{3}(0.5)^k + \frac{8}{3}(0.8)^k\right]u[k]$

(c) $y[k] = \left[-\frac{1}{3}(0.5)^k + \frac{2}{3}(0.8)^k\right]u[k]$

(d) $y[k] = \left[-(0.5)^k + (0.6)^k\right]u[k]$

80. Ans: (b)

Sol: Given $h(k) = (0.5)^k u(k)$

$f(k) = (0.8)^k u(k)$

zero state response: $y(k) = f(k) * h(k)$

$Y(z) = F(z).\ H(z)$

$$F(z) = \frac{z}{z-0.8}, H(z) = \frac{z}{z-0.5}$$

$$Y(z) = F(z)H(z) = \frac{z^2}{(z-0.8)(z-0.5)}$$

$$\frac{Y(z)}{z} = \frac{z}{(z-0.8)(z-0.5)} = \frac{A}{z-0.8} + \frac{B}{z-0.5}$$

$$Y(z) = \frac{8}{3}\cdot\frac{z}{z-0.8} - \frac{5}{3}\cdot\frac{z}{z-0.5}$$

Apply IZT

$$y(k) = \frac{8}{3}(0.8)^k u(k) - \frac{5}{3}(0.5)^k u(k)$$

81. The value of $\int x^2 e^{ax} dx$ is

(a) $\frac{e^{ax}}{a}(a^2x^2 + 3ax - 2)$

(b) $\frac{e^{ax}}{a^4}(a^3x^2 - a^2x + 2ax + 1)$

(c) $\frac{e^{ax}}{a^3}(a^2x^2 - 2ax + 2)$

(d) $\frac{e^{ax}}{a^2}(a^3x^2 - 2a^2x + 4)$

81. Ans: (c)

Sol: $\int x^2 e^{ax} dx = x^2\frac{e^{ax}}{a} - (2x)\left[\frac{e^{ax}}{a^2}\right] + (2)\left[\frac{e^{ax}}{a^3}\right]$

$$= \frac{e^{ax}}{a^3}[a^2x^2 - 2ax + 2]$$

82. What is the convolution y[n] = x[n]*h[n]: where $x[n] = \alpha^n u[n]$, $h[n] = \beta^n u[n]$, $\alpha \neq \beta$, $\alpha = 0.8$, $\beta = 0.9$?

(a) $y[n] = [9(0.9)^n - 8(0.8)^n]u[n]$

(b) $y[n] = [0.9(9)^n - 0.8(8)^n]u[n]$

(c) $y[n] = [0.3(9)^n - 0.4(8)^n]u[n]$

(d) $y[n] = [9(0.3)^n - 8(0.4)^n]u[n]$

82. Ans: (a)

Sol: Given $x(n) = (\alpha)^n u(n) = (0.8)^4 u(n)$

$h(n) = (\beta)^n u(n) = (0.9)^4 u(n)$

$y(n) = x(n) * h(n)$

Apply Z-Transform

$Y(z) = X(z).\ H(z)$

$$Y(z) = \frac{z}{z-0.8}\cdot\frac{z}{z-0.9}$$

$$\frac{Y(z)}{z} = \frac{z}{(z-0.8)(z-0.9)} = \frac{A}{z-0.8} + \frac{B}{z-0.9}$$

$$\frac{Y(z)}{z} = \frac{-8}{z-0.8} + \frac{9}{z-0.9}$$

$$Y(z) = -8.\frac{z}{z-0.8} + 9.\frac{z}{z-0.9}$$

Apply IZT

$y(n) = -8\,(0.8)^n\,u(n) + 9(0.9)^n\,u(n)$

83. Which one of the following is correct for parseval equality?

(a) $\int_{-\infty}^{+\infty} |x(t)|^2 dt = \frac{1}{2\pi}\int_{-\infty}^{+\infty} |X(j\omega)|^2 d\omega$

(b) $\int_{-\infty}^{+\infty} |x(t)^2 dt = \frac{1}{2\pi}\int_{-\infty}^{+\infty} |X(j\omega)|^{1/2} d\omega$

(c) $\int_{-\infty}^{+\infty} |x(t)|^2 dt = \frac{1}{2\pi}\int_{-\infty}^{+\infty} |X(j\omega)|^{1/2} d\omega$

(d) $\int_{-\infty}^{+\infty} |x(t)|^2 dt = \frac{4}{3\pi}\int_{-\infty}^{+\infty} |X(j\omega)|^{1/2} d\omega$

83. Ans: (a)

Sol: parseval equality is

$$\int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} |X(j\omega)|^2 d\omega$$

84. For $x(t) = \sin(10\pi t)$, what is the conditions on the sampling interval T so that x(t) is uniquely represented by the discrete-time sequence x[n] = x(nT)?

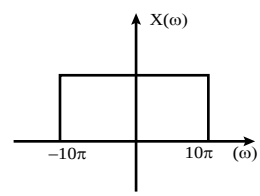
(a) $T < 1/10$ (b) $T < 1/5$

(c) $T > 1/5$ (d) $T > 1/10$

84. Ans: (a)

Sol: Given $x(t) = \frac{\sin(10\pi t)}{\pi t}$

$$\left[\frac{\sin(at)}{\pi t} \leftrightarrow \text{rect}\left(\frac{\omega}{2a}\right)\right]$$



Maximum frequency of x(t) is $\omega_m = 10\pi$

$f_m = 5$ Hz

The condition on the sampling internal 'T', so that x(t) is uniquely represented by the discrete time sequence x(n) = x(nT) is

$T < \frac{1}{2f_m}$

$T < \frac{1}{10}$

Directions: Each of the next six (06) items consists of two statements, one labelled as the 'Statment(I)' and the other labelled as 'Statment (II)'. Your are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes:

(a) Both Statment (I) and Statment (II) are individually true and Statement (II) is the correct explanation of Statement (I).

(b) Both Statment (I) and Statment (II) are individually true, but Statement (II) is **not** the correct explanation of Statement (I).

(c) Statment (I) is true, but Statement (II) is false.

(d) Statment (I) is false, but Statement (II) is true.

85. **Statment (I):** Ferromagnetic properties are confined almost entriely to iron, nickel and cobalt and their alloys.

Statment (II): By substituting the basic ferrite of magnetite with other divalent oxides, a wide range of ferrimagnetic compounds with useful properties can be produced, which have high electrical resistivity to minimize eddy currents at high frequencies.

85. Ans: (b)

Sol: Ferromagnetic materials = Fe, Co, Ni & their alloys

Ferrimagnetic materials: Fe_2O_4, $Z_nFe_2O_4$

$= (MnO)(Fe_2O_3), (ZnOFe_2O_3)$

Mn, Zn are divalent metals

Ferrimagnetic materials have high resistivity to minimise eddy currents at high frequencies.

86. **Statment (I):** The inorganic materials are used to manufacture suspension insulators for high-voltage overhead lines and bushings on high-voltage transformers and switchgear.

Statment (II): The ceramic and glass materials are formed into a series of flanged discs to decrease the creepage distance along the surface of the complete insulator.

86. Ans: (b)

Sol: Ceramics are inorgonic materials used as an insulation of high voltage overhead lines

Ex: Porcelain, glass

87. **Statment (I):** In resonant circuits, the capacitor voltage or inductor current could be much lower than the source voltage or source current, and a large input signal can produce a small output signal when resonance appears in a circuit.

Statment (II): In resonant circuits, the quality factor for a coil is defined as the ratio of the inductive reactance and the winding resistance, which is a dimensionless parameter.

87. Ans: (d)

88. **Statment (I):** The pattern of the electric field lines strongly depends on the geometric arrangement of charge carriers and the field lines always enter or exit the cahrge carrier vertically.

Statment (II): From the field pattern, a small distance between adjacent field lines (high field line density) indicates low field strength.

88. Ans: (c)

Sol: electric field intensity and its field pattern will truely depends on geometrical arrangement of charge configuration and the field strength or lines will be projected vertical or perpendicular to the given charge configuration

Statement (I) is true.

If the spacing between the adjacent field lines is smaller then there will be high field strength.

Statement (II) is false.

ACE Engineering Academy Since 1995 Leading Institute for ESE/GATE/PSUs x DEEP LEARN

89. **Statment (I):** A strain gauge pressure sensor converts the physical quantity "pressure" into an electrical signal and electrical resistance of the strain gauge changes with the tensile strain.
Statment (II): Bourdon tube pressure sensors work on the principle of change of any form of deformation, the cross-sectional tubing tends to recover its circular form under the action of pressure, which is used as mechnaical pressure measuring instrument.

Ans: (b)

90. **Statment (I):** Lightly doped n^- epitaxial layer is present in pn-junction diode.
Statment (II): Power diodes have lightly doped n^- epitaxial layer which can absorb the depletion layer during reverse biased.

Ans: (a)

91. The function of an AM detector is to demodulate the AM signal and recover
(a) the original source information with same frequencies and same relative amplitude characteristics
(b) the original source information with up-converted frequencies.
(c) the original signal with amplified output voltage
(d) the original source information with various frequencies and different amplitude characteristics.

91. Ans: (a)

Sol: AM detector is used to recover the message signal. The signal should have frequencies and amplitude.

92. Which one of the following statements is correct for the active filter using op-amps?
(a) High frequency response is limited by the gain bandwidth product and slew-rate of the op-amp.
(b) Op-amps are not providing any gain
(c) Due to the low input impedance of the op-amp, large value resistors can be used.
(d) High frequency active filters are not more expensive than passive filters.

92. Ans: (a)

Sol: 1. High frequency response in active filters is limited mainly by slew-rate OP-Amp.
2. However its a function of gain bandwidth product also.

93. What is the value of the full scale output for an 8-bit digital to analog converter for 0 V to 10 V range?
(a) 6.961 V (b) 7.891 V
(c) 8.961 V (d) 9.961 V

93. Ans: (d)

Sol: Full scale output $= \dfrac{\text{range} \times (2^n - 1)}{2^n}$

$= \dfrac{10 \times (2^8 - 1)}{2^8} = 9.961$ V

94. Lead frequency compensation is a technique used to increase
(a) the phase margin (b) the gain
(c) the bandwidth (d) the slew rate

94. Ans: (a)

Sol: Lead compensator increases the phase margin of the system.

95. Which one of the following is **not** correct for the AAA instruction in 8086 microprocessors?
(a) It works only on the AL register
(b) It updates AF and CF
(c) It checks the result for correct unpacked BCD.
(d) It updates all the flags.

95. Ans:(d)

Sol: AAA instruction in 8086 affects only CF & AF. Remaining flags are not affected.

96. Which one of the following filters is used to recover original signal from its sample?
(a) Low pass filter (b) High pass filter
(c) Band pass filter (d) Band reject filter

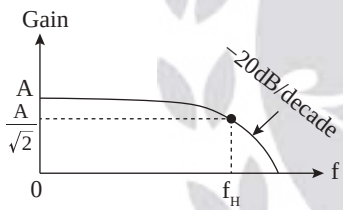
96. Ans: (a)

Sol: Low pass filter is used to recover original signal from its sample.

97. In the first order low pass filter, which one of the following statments is **not** correct?
(a) It has the maximum gain at frequency of 0 Hz
(b) At higher cutoff frequency, the gain falls to 0.707 times the maximum gain.
(c) For frequency greater than higher cutoff frequency, the gain decreases at a constant rate of –20 dB/decade.
(d) It has the maximum gain in stop band.

97. Ans: (d)

Sol:



Consider the frequency response of first order lowpass filter

1. At f = 0, the gain is maximum, A
2. At $f = f_H$, $A_{LPF} = \frac{A}{\sqrt{2}} = 0.707\ A$
3. Consider the general formula for transfer function of first order LPF:

$$|A_{LPF}| = \left|\frac{V_0}{V_i}\right| = \frac{A}{\sqrt{1+\left(\frac{f}{f_H}\right)^2}} \quad \text{..... (1)}$$

Case (i): At $f = f_H \Rightarrow A_{LPF} = \frac{A}{\sqrt{2}}$

Case (ii): If $f = 10f_H$, $A_{LPF} = \frac{A}{10}$

$= 20\log A - 20\log 10$
$= A\ (\text{in dB}) - 20\text{dB}$

i.e., for every one decade (10 times) change in input signal frequency, gain decreases by 20 dB.
∴ The gain roll-off rate in first order LPF is equal to –20dB/decade

98. The quantization error is equivalent to
(a) internal noise generated within system
(b) impulse noise
(c) inter modulation noise as it produces harmonics
(d) additive white noise as it alters the signal amplitude

98. Ans: (a)

Sol: Quantization error is introduced in the Quantization. this error is generated within the system. So it is considered as internal noise.

99. A frequency division multiplexing system is used to multiplex 24 independent voice signals. Single sideband modulation is used for the transmission. Each voice signal is allotted a bandwidth of 4 kHz. What is the overall transmission bandwidth of the cahnnel?
(a) 4 kHz (b) 6 kHz
(c) 24 kHz (d) 96 kHz

99. Ans: (d)

Sol: No. of voice signals = 24
BW of each signal = 4 kHz
Transmission BW = 24 × 4 kHz
= 96 kHz

100. A Time Division Multiplexing system is used to multiplex four independent voice signals using pulse amplitude modulation. Each voice signal is sampled at the rate of 8 kHz. The system incorporates a sysnchronizing pulse train for its proper operation. what is the timing between the synchronizing pulse trains and the impulse trains used to sample the four voice signals?
(a) 5 μs (b) 10 μs
(c) 15 μs (d) 25 μs

100. Ans: (d)

Sol: No. of signals = 4

One additional flux required for synchronization

$T_s = \frac{1}{8000} = 125\ \mu sec$

No. of pulse = 5

Time = $\frac{125}{5} = 25\ \mu sec$

101. Which one of the following statments is correct for full amplitude modulation?
   (a) The spectrum consists of two sidebands (one termed the upper sideband and the other termed the lower sideband).
   (b) The spectrum consists of one sideband (termed the upper sideband).
   (c) The spectrum consists of one sideband (termed the lower sideband)
   (d) The spectrum consists of three sidebands (one termed the upper sideband, the second termed the lower sideband, and the third termed the lowest sideband).

101. Ans: (a)

Sol: All spectrum consists of upper side band and lower side band.

102. The highest frequency component of a speech signal needed for telephonic communications is about 3.1 kHz. What is the suitable value for the sampling rate?
   (a) 1 kHz (b) 2 kHz
   (c) 4 kHz (d) 8 kHz

102. ans: (d)

Sol: Given maximum frequency of the signal is

$f_m = 3.1kHz$

The sampling rate must be $f_s \geq 2$ fm

$f_s \geq 6.2$ kHz

103. Which one of the following is the advantage of FIR filter over IIR filter?
   (a) FIR filter can have an exact linear phase
   (b) FIR filter is always unstable
   (c) For FIR filter, the design methods are non-linear
   (d) FIR filter cannot be realized efficiently in hardware.

103. Ans: (a)

Sol: FIR filters can have an exact linear phase.

104. Consider the following statements for a periodic signal:
   1. Both the magnitufe and phase spectra are line spectra
   2. For real-valued signals, the magnitude spectrum has even symmetry
   3. For real-valued signals, the phase has odd symmetry

   Which of the above statements are correct?
   (a) 1 and 2 only (b) 1, 2 and 3
   (c) 2 and 3 only (d) 1 and 3 only

104. Ans: (b)

Sol: For a periodic signal

1. Magnitude and phase spectrum are line spectrums
2. If signal is real valued, magnitude spectrum has even symmetry.
3. If signal is realvalued, the phase spectrum is odd symmetry.

105. Consider the following statments regarding power of a continuous-time and discrete-time signals:
   1. Power is the time average of energy
   2. A signal with finite energy has zero power
   3. A signal with finite power has infinite energy
   4. All finite periodic signals are power signals

   Whihc of the above statements are correct?
   (a) 1,2,3 and 4 (b) 1,2 and 3 only
   (c) 2,3 and 4 only (d) 1 and 4 only

105. Ans: (a)

Sol: 1. $P_{x(t)} = \frac{1}{T}\int_{-T/2}^{T/2} |x(t)|^2 dt$ so, power is the time average of Energy. (1) is true.

2. A signal with finite energy has zero power (2) is true
3. A signal with finite power has infinite energy. (3) is true
4. All finite periodic signals are power signals, (4) is true

106. If P_1 and P_2 be the iron and copper losses of a transformer on full-load, what is the ratio of P_1 and P_2 such that maximum efficiency occurs at 75% full-load?

(a) 4/3 (b) 3/4

(c) 5/7 (d) 9/16

106. Ans: (d)

Sol: Given Iron loss = P_1

Copper loss = P_2 at full load

At maximum efficiency, $\frac{3}{4} = \sqrt{\frac{\text{Iron loss}}{\text{ful load cu loss}}}$

$\Rightarrow \left(\frac{3}{4}\right)^2 = \frac{P_1}{P_2}$

$\Rightarrow \frac{P_1}{P_2} = \frac{9}{16}$

107. Which one of the following statements is **not** correct regarding simplex lap winding of a DC machine?

(a) The total number of brushes is equal to the number of poles

(b) The number of parallel paths in the armature is two

(c) The emf between the positive and the negative brushes is equal to the emf generated in any one of the parallel paths

(d) If Z is the total number of armature conductors and P is the number of poles, then the number of armature conductors in any parallel path is Z/P.

107. Ans: (b)

Sol: Since, no. of paralle paths, A = no. of poles, P

108. The single-phase reluctance machine can be made to work as a generator when mechnaical power is supplied to the shaft. This is possible when

(a) mechanical power is increased and angle becomes negative

(b) mechnical power is increased and angle becomes positive

(c) mechnical power is decreased and angle becomes 60^o

(d) mechnical power is decreased and angle becomes 45^o

108. Ans: (b)

Sol: Reluctance generator is an unexcited salient pole synchronous generator. As mechanical power is increased, it will deliver equivalent electrical power.

The power developed by the generator (P_{rel})

$$P_{rel} = \frac{V^2}{2}\left(\frac{1}{X_q} - \frac{1}{X_d}\right)\sin 2\delta$$

Where 'δ' is the load angle which is always positive for generator.

The maximum power developed will be at $\delta = 45°$.

If 'δ' is more than 45°, the generator will losses its stability. For stable operation, $\delta \le 45°$.

109. If the flux linkage-current characterisitic is linear, then

(a) the field energy is greater than the coenergy

(b) the field energy is less than the coenergy

(c) the field energy is equal to the coenergy

(d) the field energy and the coenergy do not have any dependence on flux linkage-current characteristic.

109. Ans: (c)

Sol: If the flux linkages (ψ) ~ current (i) characteristic is linear

ACE® Engineering Academy Since 1995 x DEEP LEARN
Leading Institute for ESE/GATE/PSUs

GATE + PSUs 2022

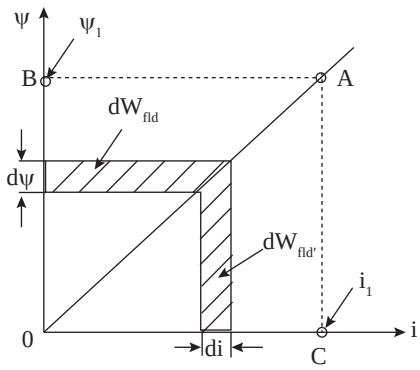
Exclusive Online Live

Rank Improvement Batch

Start from:

10th JULY, 2021

Discount of Rs.5,000/-
for IIT/NIT/IIIT students,
below 5,000 GATE rankers, ESE Prelims cleared students
ESE Mains cleared students and ACE old students.



- The field energy, $W_{fld} = \int_0^{\psi_1} dW_{fld} = \int_0^{\psi_1} id\psi$

  = area OABO

  The area OABO is called field energy
- The area OACO is called co-energy W_{fld}'

  $W_{fld}' = \int_0^{i_1} \psi di$ = area of OACO
- With no magnetic saturation (i.e., ψ - i characteristic is linear), then

  Area OABO = area OACO

  $W_{fld} = W_{fld}'$

  $\therefore$ field energy = Co-energy

  field energy = co-energy = $\frac{1}{2}\psi i$

110. An 8-pole generator has an output of 200 A at 500 V, the lap-connected armature has 1280 conductors, 160 commutator segments. If the brushes are advanced 4-segments from the no-load neutral axis, what is the cross-magnetising ampere-turns per pole?

(a) 1600 (b) 1400

(c) 1550 (d) 1200

110. **Ans: (d)**

Sol: Given, P = 8; A = 8; Z = 1280; I_a = 200 A

$\theta_{mech} = \frac{4}{160} \times 360 = 9°$

$\theta_{elec} = \frac{8}{2} \times 9 = 36°$

$\therefore$ Cross magnetising ampere turn per pole,

$AT_c/p = \frac{180 - 2\theta}{180} \times \frac{ZI_a}{2AP}$

$= \frac{180 - 2 \times 36}{180} \times \frac{1280 \times 200}{2 \times 8 \times 8}$

$= 1200$

111. A 400 V, 1000A, lap-wound DC machine has 10 poles and 860 armature conductors. What is the number of conductors in the pole face to give full compensation if the pole face covers 70% of the pole span?

(a) 1000 (b) 4000

(c) 2050 (d) 3010

111. **Ans: (*)**

Sol: No option satisfy

(Given options of Ampere turn per pole)

Given: I_a = 1000 A

P =10

A = 10

Z = 860

Total Amp. turn per pole, $\frac{ZI_a}{2AP}$

$\frac{ZI_a}{2AP} = \frac{860 \times 1000}{2 \times 10 \times 10} = 4300$

$\therefore$ Compensating winding ampere turn's per pole,

ATc = 4300 × 0.7 = 3010

$\therefore$ No. of pole face condcutors = $\frac{3010 \times 2}{1000}$

= 6.02

i.e., 6 conductors

112. The main function of electric power system is to

(a) transmit energy with maximum efficiency

(b) generate energy with minimum efficiency

(c) store energy with maximum efficiency

(d) convert energy with minimum effieciency

112. Ans: (a)

Sol: The main function of electrical power system is to generate, transmit and distribute good quality electrical energy with less energy loss or maximum efficiency.

So, correct option will be (a)

113. Which of the following are the sources of heat generation within the cables?

1. I^2R losses in theconductor
2. Dielectric losses in the cable insulation
3. Losses in the metallic sheath and armourings.

Select the correct anser using the code given below:

(a) 1 and 2 only (b) 1,2 and 3

(c) 2 and 3 only (d) 1and 3 only

113. Ans: (b)

Sol: Generally losses in the cables are

1. I^2R loss in the conductor or core
2. Dielectric power loss in cable dielectric material.
3. Loss in sheath and armouring because of mutual induction between conductor and sheath, armouring.

So correct option will be (b)

114. The radical distribution is simple and economical, but the reliability of the system is poor and leads to

(a) evacuating of energy supply if there is fault in the line

(b) transmission of energy supply if there is fault in the line

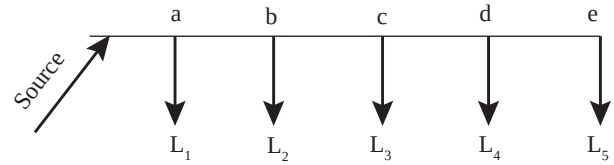
(c) distribution of energy supply if there is fault in the line

(d) interruption of energy supply if there is fault in the line

114. Ans: (a)

Sol: (There is a spelling mistake in the first line of problem, the term radial printed as radical).

Let us consider a radial system,



L_1 to L_5 given in figure are loads in system. If any fault occurs in any section, definitely some of these loads (Loads above the faulted section will be disconnected because of the operation of respective switch gear elements. So relaiability of system will be less onto a fault.

It leads to evacuvating of the energy supply because few loads will be disconnected.

Correct option will be (a).

115. Which one of the following statments is correct regarding fault analysis?

(a) Balanced three-phase voltages contain zero-sequence components.

(b) Balanced three-phase voltages do not contain negative sequence components.

(c) Balanced three-phase voltages contain only negative sequence components

(d) Balanced three-phase voltages contain positive and negative sequence components

115. Ans: (b)

Sol: Balanced three phase voltages means, the voltages consists either only positive sequence or only negative sequence (mathematically).

But the convention is positive sequence is the original sequence of system. So, it can be considered that the system is balanced if it consists only positive sequence voltages. So it can be said that balanced voltages do not contain any negative sequence compoenents.

Correct option will be (b)

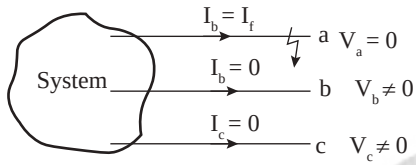
116. For a single-line to ground fault, the terminal condtions are

(a) $V_a = 0, I_b = I_c = 0$ (b) $I_b = -I_c, V_a = V_c$

(c) $I_a = I_c, V_b = V_c$ (d) $I_a = 0, V_b = V_c$

116. Ans: (a)

Sol: For lien to ground fault on phase-a



So, correct option will be $V_a = 0, I_b = I_c = 0$

Option (a) is correct.

117. The per unit impedance of a circuit element is x. If the base kV and base MVA are dobuled, then the new value of the per unit impedance of the circuit element is

(a) x (b) x/2

(c) 2x (d) x/4

117. Ans: (b)

Sol: P.u. impedance of element = X

Let the old base values are $V_{b\,old}$, $S_{b\,old}$.

New base values are $V_{b\,new} = 2.V_{b\,old}$ and

$$S_{b\,new} = 2.S_{b\,old}$$

New p.u. impedance of element

$$= X.\left(\frac{V_{b\,old}}{V_{b\,new}}\right)^2.\left(\frac{S_{b\,new}}{S_{b\,old}}\right)$$

$$= X.\frac{1}{4}.2 = \frac{X}{2}$$

Option (b) is correct.

118. The fill factor of a photovoltaic module is 0.8. A single cell in a module has an open circuit voltage of 0.6 V and short circuit current of 8A. The module has 48 cells connected in series. If the voltage at maximum power is 0.9 times open circuit voltage, the current at maximum power is

(a) 8.21 A (b) 7.11 A

(c) 6.32 A (d) 5.45 A

118. **Ans: (b)**

Sol: Fill Factor (FF) of PV cell = 0.8

$$FF = \frac{V_{mp}.I_{mp}}{V_{oc}.I_{sc}}$$

OC voltage, $V_{OC} = 0.6$ V

SC current, $I_{SC} = 8$ A

Number of cells connected in series = 48

Voltage at maximum power, $V_{mp} = 0.9V_{OC}$

$= 0.9 \times 0.6$

$= 0.54$ V

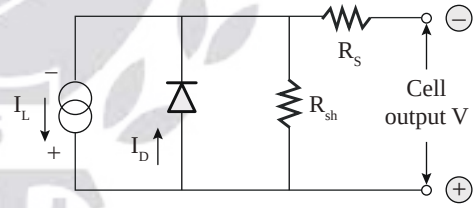
Now from FF definition, $0.8 = \frac{(48 \times 0.54) \times I_{mp}}{(48 \times 0.6) \times 8}$

$$I_{mp} = \frac{0.6 \times 8 \times 0.8}{0.54} = 7.111 \text{ A}$$

Current at maximum power, $I_{mp} = 7.11$ A

Option (b) is correct.

119. The equivalent circuit of a photovoltaic module is presented below:



The requirements for more power production are

(a) I_L should be maximum , R_s should be large, R_{sh} should be small

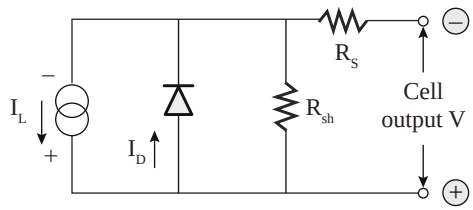
(b) I_L should be minimum , R_s should be small, R_{sh} should be large

(c) I_L should be maximum , R_s should be small, R_{sh} should be large

(d) I_L should be minimum , R_s should be large, R_{sh} should be small

119. Ans: (c)

Sol: Equivalent circuit of PV cell given as,



To have maximum power output from cell,

1. series resistance (R_s) must be very low such that voltage drop is low and cell output voltage will be high.
2. Shunt resistance (R_{sh}) must be very hight such that current drop will be low and cell output current will be high
3. To have good output current from the cell, 'I_L' current (photon current) must be very high.

So, correct option will be (c)

120. Electricity supply systems are invariably three-phase and they are so designed and loaded that the operation is
(a) star connected
(b) balanced three-phase
(c) unbalanced three-phase
(d) delta connected

120. Ans: (b)

Sol: Generally loading on power system network done to achieve a balanced operation.
so, correct option will be (b)

121. Which of the following is a powerful frequency domain method of extracting the information regarding stability as well as relative stability of a system without the need to evaluate roots of the characteristic equation?
(a) Routh criterion only
(b) Root locus method only
(c) Both Routh criterion and Root locus method
(d) Nyquist criterion

121. Ans: (d)

Sol: Nyquist criterion gives gain margin, phase margin and the number of right half of s-plane poles of a system.

122. Consider the following system:

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix}=\begin{bmatrix}-0.5 & 0\\ 0 & -2\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u(t)$$

$$\text{and } y(t)=\begin{bmatrix}0 & 1\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}$$

The system is
(a) controllable and observable
(b) uncontrollable only
(c) unobservable only
(d) uncontrollable and unobservable

122. Ans: (d)

Sol: Applying the Gilberts test system is neither controllable nor observable.

123. Whcih one of the following is not correct with reference to proprotional-derivative (PD) controller?
(a) PD control action reduces rise time of the system
(b) PD control action improves the damping
(c) PD control action decreases the bandwidth
(d) PD control action reduces the overshoot.

123. Ans: (c)

Sol: PD controller increases the bandwidth

124. Consider the following statments for lag-lead compensator:
1. It is a combination of a lag compensator and a lead compensator
2. The lag-section has one real pole and one real zero with the pole to the right of the zero
3. The lead-section has one real pole and one real zero with the zero to the right of the pole

ACE Engineering Academy
Since 1995
Leading Institute for ESE/GATE/PSUs
x DEEP LEARN

ACE SCHOLARSHIP TEST

APPSC / TSPSC / SSC

Exam Date : 8th AUGUST 2021
Timing: 11:00 am to 12:00 pm

No. of Questions	: 50 Q
50 Q	: 1 Mark
Total Marks	: 50 Marks
Duration	: 60 Mins.

ONLINE MODE

- AI based proctoring examination
- candidates can take the online test from any location using a laptop/ PC with a connected webcam and good internet connection.
- Audio and video must be turned on through out the duration of the test.

EXAM SYLLABUS

1. Biology
2. Science & Technology
3. Physics.
4. Chemistry
5. Polity
6. Geography
7. Indian Economy

PAPER GENERAL SCIENCE

Applicable for:

DEEP LEARN | LIVE CLASSES | CLASSROOM COACHING

Last Date to Apply 6TH August 2021
Fee: Rs.100/- Only

Allocation of Scholarships

75% Fee Waiver*	60% Fee Waiver*	50% Fee Waiver*
1st Position	2nd Position	3rd Position

♦ 30% Fee Waiver* 4th Position ♦ 20% Fee Waiver* 5th Position

For attaining scholarships, the above positions have to achieve a minimum of **40% marks.**

Registrations start from: 20th July, 2021

Call: 040-23234418/19/20 aceenggacademy.com

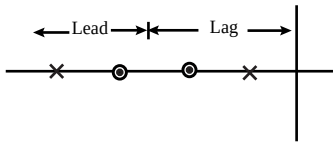
With of the above statements are correct?

(a) 1 and 3 only (b) 2 and 3 only

(c) 1 and 2 only (d) 1,2 and 3

124. Ans: (d)

Sol: Pole zero plot of a lag-lead compensator is shown below.



125. The ramp response for a system whose transfer function $G(s)=\frac{s}{(s+4)(s+8)}$ is

(a) $c(t)=\frac{1}{2}e^{-4t}+\frac{1}{2}e^{-8t}$

(b) $c(t)=\frac{1}{2}e^{-4t}-\frac{1}{2}e^{-8t}$

(c) $c(t)=\frac{1}{32}-\frac{1}{16}e^{-4t}+\frac{1}{32}e^{-8t}$

(d) $c(t)=\frac{1}{32}-\frac{1}{12}e^{-4t}-\frac{1}{16}e^{-8t}$

125. Ans: (c)

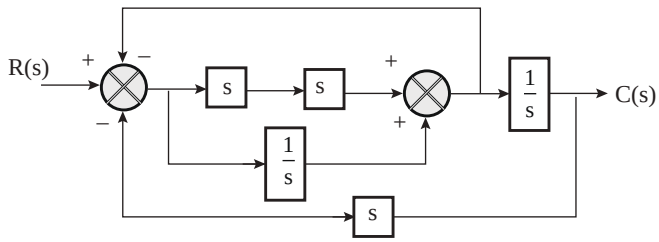
Sol: $\text{output}=\frac{s}{(s+4)(s+8)}\ \frac{1}{s^2}$

$$=\frac{1}{s(s+4)(s+8)}$$

$$=\frac{1}{32}s-\frac{1}{16}\ \frac{1}{s+4}+\frac{1}{32}\ \ \frac{1}{(s+8)}$$

$$=\frac{1}{32}-\frac{1}{16}e^{-4t}+\frac{1}{32}e^{-8t}$$

126. In the figure, if C(s) is the Laplace transform of the output and R(s) is the Laplace transfrom of the input, the equivalent transfer function T(s) is



(a) $T(s)=\frac{s^3+1}{2s^4+s^2+2s}$

(b) $T(s)=\frac{s^3+1}{2s^4+s^2-s}$

(c) $T(s)=\frac{s^3+1}{2s^4+s^2+1}$

(d) $T(s)=\frac{s^3-1}{2s^4+s^2+2}$

126. Ans: (a)

Sol: Applying Mason's gain formula

$$\frac{C(s)}{R(s)}=\frac{s^2\frac{1}{s}+\frac{1}{s^2}}{1-\left[-s^2\frac{1}{s}s-s^2-\frac{1}{s}.\frac{1}{s}.s-\frac{1}{s}\right]}$$

$$\frac{C(s)}{R(s)}=\frac{s^3+1}{2s^4+s^2+2s}$$

127. Consider the following statements related to stability of the control system:

1. Poles in right half-plane (rhp) yield pure exponential decaying natural response
2. If poles of multiplicity greater than one are present on the imaginary axis, then the system is marginally stable.
3. If one pole is present in right-half plane, the system is unstable
4. A system is stabel if the natural response approaches zero as time approaches infinity

Which of the above statements is/are not correct?

(a) 1 and 4 only (b) 1 and 2 only

(c) 1 only (d) 3 and 4 only

Ans: (b)

128. The state equation and the output equations of the system are as follows:

$$\dot{x}=\begin{bmatrix}0&1&2\\5&6&9\\5&3&9\end{bmatrix}x+\begin{bmatrix}1\\0\\0\end{bmatrix}u$$

$$y=\begin{bmatrix}1&0&0\end{bmatrix}x$$

Where x is the state variable, u is the input variable and y is the output variable. What is the number of right-half poles?

(a) 0 (b) 1 (c) 2 (d) 3

128. Ans: (c)

Sol: Characteristic equation $|SI-A| = 0$

$$\begin{bmatrix} s & 0 & 0 \\ 0 & s & 0 \\ 0 & 0 & s \end{bmatrix} - \begin{bmatrix} 0 & 1 & 2 \\ 5 & 6 & 9 \\ 5 & 3 & 9 \end{bmatrix} = \begin{bmatrix} s & -1 & -2 \\ -5 & s-6 & -9 \\ -5 & -3 & s-9 \end{bmatrix}$$

$s^3 - 15s^2 + 12s + 30 = 0$

RH-tabulation:

s^3	1	12
s^2	−15	30
s^1	14	
s^0	2	

Two sign changes hence

number of right hand poles = 2

129. In minimm phase transfer function, the transfer functions have

(a) neither poles nor zeros in the right-half s-plane

(b) Poles in right-half s-plane and zeros in left-half s-plane

(c) poles in left-half s-plane and zeros in right-half s-plane

(d) poles and zeros in the right-half s-plane

129. Ans: (a)

130. Which one of the following statments is not correct regarding lap and wave winding?

(a) Lap-winding is suitable for high-voltage but low-current generators

(b) Lap-winding is suitable for low-voltage but high-current generators

(c) Wave-winding is used for high-voltage, low-current machines.

(d) When large currents are required, it is necessary to use lap-winding

130. Ans: (a)

Sol: (a) is not correct

Since, Lap winding is switchable for low voltage and high current applications.

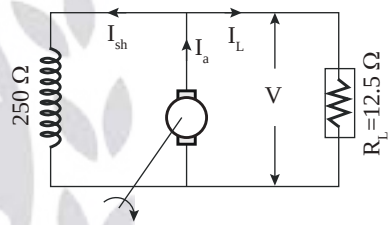
131. An 8-pole DC shunt generator with 778 wave-connected armature conductors and running at 500 rpm supplies a load of 12.5 Ω resistance at terminal voltage of 250 V. The armature resistance is 0.24 Ω and field resistance is 250 Ω. The magnitude of armature current is

(a) 20 A (b) 10 A

(c) 21 A (d) 11 A

131. Ans: (c)

Sol: Given: P = 8



$$I_{sh} = \frac{250}{250} = 1\text{ A} \quad \text{and } I_L = \frac{250}{12.5} = 20\text{ A}$$

$$\therefore I_a = I_L + I_{sh} = 20 + 1 = 21\text{ A}$$

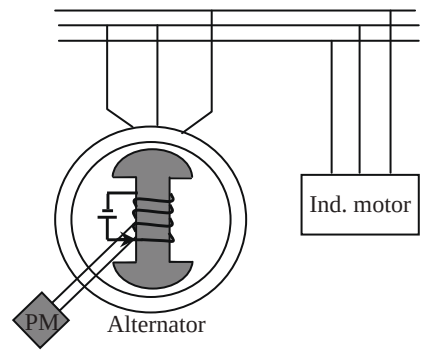
132. A 12-pole, 3-phase alternator driven at a speed of 500 rpm, supplies power to an 8-pole, 3-phase induction motor. If the slip of the motor at full-load is 3%, what is the full-load speed of the motor?

(a) 525.5 rpm (b) 627.5 rpm

(c) 727.5 rpm (d) 826.5 rpm

132. Ans:(c)

Sol:



Alternator:

No. of poles, P = 12, 3- ϕ

Speed N = 500 rpm

Frequency, $f = \frac{PN}{120} = \frac{12 \times 500}{120} = 50$ Hz

Induction motor:

P = 8

3 - ϕ

Slip, s = 3%

Synchronous speed, $N_S = \frac{120f}{P}$

$= \frac{120 \times 50}{8} = 750$ rpm

Rotor speed, $N_r = N_S(1 - s)$

$= 750(1 - 0.03)$

$= 727.5$ rpm

133. A 300 kVA, single-phase transformer is designed to have a resistance of 1.5 % and maximum efficiency occurs at a load of 173.2 kVA. What is the efficiency when supplying full-load at 0.8 pf lagging at normal voltage and frequency?

(a) 68.2 % (b) 76.3 %

(c) 89.1% (d) 97.6%

133. Ans: (d)

Sol: Given: %R = 1.5%

$\%R = \frac{W_{FL\,cu}}{VA} \times 100$

$1.5 = \frac{W_{FL\,cu}}{300 \times 10^3} \times 100$

Full load cu loss, $W_{FL\,cu} = 4500$ W

@ $\eta_{max} \Rightarrow$ x(F.L kVA) = 173.2

Fraction of load $\Rightarrow x = \frac{173.2}{300} = 0.577$

$\therefore \eta_{max} \Rightarrow x = \sqrt{\frac{W_i}{W_{FL\,cu}}}$

$W_i = 1498.18$ W

$\therefore \eta_{FL,\,0.8\,pf} = \frac{1(300 \times 10^3) \times 0.8}{300 \times 10^3 \times 0.8 + 1498.18 + 4500}$

$= 97.56\%$

134. A sinusoidal flux 0.02 Wb links with 55 truns of a transformer secondary. What is the rms value of the induced emf in the secondary, if the supply frequency is 50 Hz?

(a) 244.2 V (b) 334.2 V

(c) 414.2 V (d) 504.2 V

134. Ans: (a)

Sol: Emf induced on secondary

$E_2 = 4.44\phi f N_2$

$= 4.44 \times 0.02 \times 50 \times 55$

$= 244.2$ V

135. A stepper motor with a step angle of 15º has a stepping frequency of 300 steps/sec. What is the motor speed?

(a) 750 rpm (b) 650 rpm

(c) 780 rpm (d) 950 rpm

135. Ans: (a)

Sol: Step angle, $\beta = 15°$

Frequency, f = 300 steps/sec

Speed $N = \frac{\beta \times f}{360}$ rps

$= \frac{\beta \times f}{360} \times 60$ rpm

$= \frac{15 \times 300}{360} \times 60$

$= 750$ rpm

136. Which one of the following power plants is the least reliable?

(a) Tidal (b) Solar

(c) Wind (d) Geothermal

136. Ans: (b)

Sol: The four plants given in options are Tidal, Solar, wind, Geothermal.

ACE Engineering Publications
(A Sister Concern of ACE Engineering Academy, Hyderabad)

POSTAL COACHING

ESE | GATE | PSUs | **SSC**

ACE Engineering Academy, the leading institute for GATE, ESE and SSC-JE and PSUs offers postal coaching (Distance learning programme) for engineering students.

040-40044403, 040-23234420 acepostalcoaching@gmail.com

ACE PUBLICATIONS

www.aceengineeringpublications.com

25% DISCOUNT AVAILABLE

amazon

Flipkart

Tidal plant: It generates power according to tidal height variations. This plant can supply power during low tide and high tide surges and it is reliable to produce power in specific timings

Solar: It can generate power only during day time but it can be interrupted by clouds some times. It can generate only under good sun light. So this plant may not be reliable always.

Wind: It can generate power almost throughout the day because wind blow exist all the day. So, it has good reliability compared to solar.

Geothermal: After finding a hot spring, this plant is reliable to supply power throughout the day upto some years.

Among four plants solar might have least reliability.

Correct option will be (b).

137. When a synchronous motor runs at no load with adjustable excitation over a wide range, power factor can be improved by varying the excitation of its

(a) field winding (b) armature winding

(c) commutator winding (d) compound winding

137. Ans: (a)

Sol: By varying the field excitation of synchronous motor, the power factor can be controlled.

The power factor can be controlled both for lag and lead. The variation of power factor w.r.t field excitation is inverted V(i.e., $\wedge$) curve.

138. What is the maximum number of points of light, fans and 5 A socket outlets that can be connected in one circuit as per recommendation of Indian Standards?

(a) 8 (b) 10

(c) 12 (d) 9

138. Ans: (b)

Sol: According to Indian standards, and IE rules for domestic wiring the maximum number of light, fans and 5 A socket outlets that can be connected in one circuit are 10.

One circuit means it is one lighting circuit which is run of 3 wires of 2.5 sq.mm guage, the load on one lighting circuit was limited to 800 watts.

Correct answer is option (b).

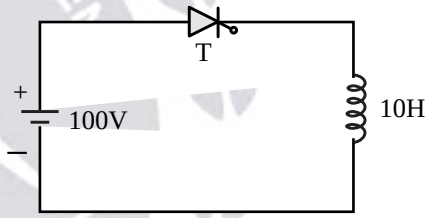
139. A DC suply of 100 V feeds an inductnace of 10 H through a thyristor. What is the minimum width of the gate pulse so that the thyrisotor is triggered, if the latching current of thyristor is 80 mA?

(a) More than 8 ms (b) Less than 8 ms

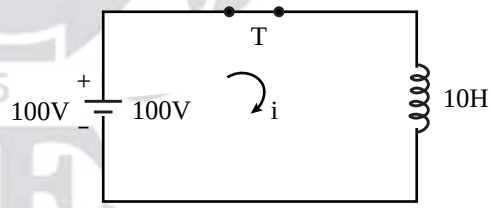
(c) Exact 6 ms (d) Less than 6 ms

139. Ans: (a)

Sol:



$i_L = 80$ mA; $t_p = ?$ for $t > 0$;



KVL to loop

$$+100 - 10 \times \frac{di}{dt} = 0$$

$$\therefore\ 100 = 10 \times \frac{di}{dt}$$

$$\therefore\ 10 = \frac{di}{dt}$$

$$10 = \frac{i_L}{t_p}$$

$$t_p = \frac{80 \times 10^{-3}}{10}$$

$$\therefore\ t_p = 8 \text{ msec}$$

140. Consider the following statements with regards to IGBTs:
1. At highest temperature, maximum current rating goes down to 2/3 value
2. IGBT is the preferred device for applications that require high blocking voltages and lower operating frequencies.
3. Turn-on transients are identical to MOSFETs

Which of the above statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1,2 and 3

Ans: (c)

141. What is the supply frequency for the case hardening of shaft having specific resistivity of 5×10^{-5} Ω-cm and the relative permeabiltiy equal to 1 for depth of heating 2.5 mm?
(a) 20.24 kHz (b) 26.24 kHz
(c) 15.62 kHz (d) 32.15 kHz

141. Ans: (a)

Sol: In case of hardening of shaft (high frequency eddy current heating) by the use of Bessel function the depth of penetradion

$$d = \frac{1}{2\pi}\sqrt{\frac{10^9}{\mu_r.\sigma.f}}\,cm$$

n data given, $P = 5\times10^{-5}\ \Omega - cm$

$\mu_r = 1$

d = 2.5 mm

$= 2.5\times10^{-1}$ cm

= 0.25 cm

$$0.25 = \frac{1}{2\pi}\sqrt{\frac{10^9}{1\times f}\times 5\times 10^{-5}}$$

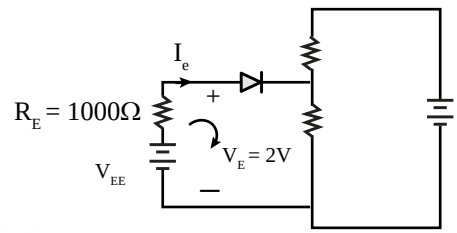
$$(2\pi\times 0.25)^2 = \frac{5\times10^4}{f} \Rightarrow f = 20.264kHz$$

142. If R_E = 1kΩ, V_E = 2V and I_v = 5 mA, what is the value of V_{EE} which will cause the UJT to turn 'off'?
(a) 2 V (b) 5 V
(c) 9 V (d) 7 V

142. Ans: (d)

Sol: When emitter current I_e falls below I_v, UJT will turn-OFF

$R_E = 1000\ \Omega$, $V_E = 2V$, $I_v = 5mA$



if, $I_e < I_V$, UJT OFF

$I_e < 5mA$

KVL:

$V_{EE}+I_eR_E+V_E = 0$

$$I_e = \frac{V_{EE}-V_E}{R_E}$$

$$5\times10^{-3} = \frac{(V_{EE}-2)}{1k}$$

$(V_{EE} - 2) = 5V \rightarrow V_{EE} = 7V$

so, if $V_{EE} < 7V$

UJT will be OFF when the voltage is less than 7 V

143. In a 110 V DC chopper drive using the CLC scheme, the maximum possible value of the accelerating current is 300 A. The lower limit of the current pulsation is 140 A. What is the maximum limit of current pulsation?
(a) 140A (b) 440 A
(c) 160 A (d) 150 A

143. Ans: (c)

Sol: Given

I_{0max} = 300 A

I_{0min} = 140A

so, maximum limit of current pulsation = $I_{pp} = I_{0max} - I_{0min}$

= 300 – 140

= 160 A

Hearty Congratulations to our

GATE 2021 TOP RANKERS

and many more...

Total 57 Ranks in Top 10

ME : 10	PI : 09	CE : 08	EE : 4	EC : 09	CS : 03	IN : 08	XE : 06

144. A three-phase squirrel-cage induction motor is developing torque of 1500 sync.watts at 50 Hz and 1400 rpm (synchronous speed is 1500 rpm). If the motor frequency is now increased to 75 Hz using constant power mode, what is the new value of torque developed by the motor at constant slip?

(a) 1500 sync.watts (b) 7500 sync.watts
(c) 1000 sync.watts (d) 2250 sync.watts

144. Ans: (c)

Sol: Neglecting stator losses

$$T_{em} = \frac{180}{2\pi N_S} \cdot \frac{SV^2}{R_2}$$

At constant slip

$$T_{em} \propto \frac{1}{f}$$

Where f is the stator frequency

Given T_{em1} = 1500 sy. watts

f_1 = 50 Hz

T_{em2} = ?

f_2 = 75 Hz

$$\frac{T_{em1}}{T_{em2}} = \frac{f_2}{f_1}$$

$$T_{em2}\,(sy.w) = \frac{f_1}{f_2} \times T_{em1}$$

$$= \frac{50}{75} \times 1500$$

$$= 1000 \text{ sy.W.}$$

145. A UPS is driving a 600 W load which has a lagging power factor of 0.8. The efficiency of the inverter is 80%. The battery voltage is 24 V DC. Assume that there is a separate charger for the battery. What is the rating of the inverter?

(a) 1.5 kVA (b) 0.5 kVA
(c) 0.75 kVA (d) 2.5 kVA

145. Ans: (c)

Sol: Rating of inverter in kVA = $\frac{600}{0.8 \times 1000}$

= 0.75 kVA

146. A boost converter having an input voltage of 20 V is connected to a resistive load. the value of inductance is 1 mH with an equivalent series resistance of 0.1Ω. If the duty ratio of the converter is one, then the output voltage is

(a) zero (b) 20 V
(c) 40 V (d) infinite

146. Ans: (a)

Sol: $M = \frac{V_0}{V_{in}} = \frac{1}{(1-\delta) + \frac{r_L}{(1-\delta)R}}$

But here $\delta = 1$

So, M = 0

So, $V_0 = 0$

147. In comparing the operation of the half-controlled 2-pulse circuit with that of the fully-controlled circuit, which of the following statements are evident?

1. Since half the thyristors are replaced by diodes, a half-controlled converter costs less than a fully-controlled converter.
2. Due to the freewheeling action with half-controlled bridge-circuit power factor is improved in half-controlled converters
3. The AC supply current is more distorted due to its zero periods with half-controlled circuit, compared to fully-controlled bridge-circuit.

Select the correct answer using the code given below:

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Ans: (d)

148. A DC chopper circuit connected to a 100 V DC source supplies an inductive load having 40 mH in series with a resistance of 5 Ω. A freewheeling diode is placed across the load. The load current varies between the limits of 10 A and 12 A. What is

the time ratio of the chopper?

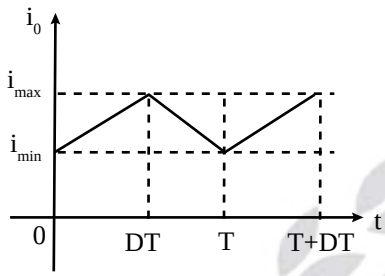
(a) 12.22 (b) 1.222

(c) 2.111 (d) 21.11

148. Ans: (b)

Sol: $V_s = 100V$; $R = 5\Omega$; $L = 40 \times 10^{-3}$ H

$i_{min} = 10A$; $i_{max} = 12$ A



$$i_{0avg} = \frac{i_{min} + i_{max}}{2} = \frac{10 + 12}{2} = 11A$$

$V_{0avg} = i_{0avg} \times R$

$= 11 \times 5$

$V_{0avg} = 55V$

$$\text{duty cycle } D = \frac{V_{0avg}}{V_s}$$

$$= \frac{55}{100}$$

$D = 0.55$

$T_{ON} = DT$

$= 0.55\ T$

$T_{off} = T - DT$

$= 0.45\ T$

$$\therefore \text{ time ratio} = \frac{T_{ON}}{T_{OFF}}$$

$= 1.222$

149. What is the minimum capacitance for the supply transformer rated 5 kVA with secondary voltage of 120V RMS and swtiching frequency of 400 Hz?

(a) 0.92 μF (b) 0.76 μF

(c) 0.52 μF (d) 0.25 μF

Ans: (*)

150. A 220V, 960 rpm, 80 A separately excited DC motor has an armature resistance 0.06 Ω. Under rated conditions, the motor is driving a load whose torque is constant and independent of speed. the speeds below the rated speed are obtained with armature voltage control and the speeds above the rated speed are obtained by field control. What is the motor terminal voltage, when the speed is 620 rpm?

(a) 68.98 V (b) 143.78 V

(c) 215.22 V (d) 320.11 V

150. Ans: (b)

Sol: $V_1 = 220V$

$I_{a1} = 80A$

$R_a = 0.06\ \Omega$

$N_1 = 960$ rpm

$N_2 = 620$ rpm

$E_{b1} = V_1 - I_{a1}R_a$

$= 220 - 80 \times 0.06$

$E_{b1} = 215.2$ V

$$\frac{N_2}{N_1} = \frac{E_{b2}}{E_{b1}}$$

$$\frac{620}{960} = \frac{E_{b2}}{215.2}$$

$\Rightarrow E_{b2} = 138.98$

$\therefore V_2 = E_{b2} + I_{a2}R_a$

$I_{a2} = I_{a1} = 80$ A

Since Torque = constant

$\therefore V_2 = 138.98 + 80 \times 0.06$

$= 143.78$ V

Hearty Congratulations to our

ESE - 2020 TOP RANKERS

AIR 1  CHARUDATTA S ME

AIR 1  SHASHANK GAUR EE

AIR 1  PRAKASH JHA E&T

AIR 1  GAURAV KUMAR CE

AIR 2  K S SHARADRAO ME

AIR 2  ABHISHEK SINGH EE

AIR 2  PARTH BATRA E&T

AIR 2  PRASHANT SINGH CE

AIR 3  SURAJ KUMAR S ME

AIR 3  VIKASH SHANKAR EE

AIR 3  RAHUL NAREDI E&T

AIR 3  KULDEEP JANGRA CE

AIR 4  SHUBHAM B ME

AIR 4  ANUPAM S EE

AIR 4  SHUBHAM E&T

AIR 4  ANISH BAGGA CE

AIR 5  KAMLESH PARWAR ME

AIR 5  MANOJ KUMAR E&T

AIR 5  PAVITRA GOYAL CE

AIR 6  MD ZUHAIB ME

AIR 6  VISHWA SIMHAA EE

AIR 6  SAURAV KUMAR S E&T

AIR 7  PRATEEK S ME

AIR 7  DINESH KUMAR S EE

AIR 7  RAGHAV PURWAR E&T

AIR 8  V SAIKRISHNA REDDY ME

AIR 8  GAGAN GHUNAWAT EE

AIR 8  RAM KRISHNA E&T

AIR 9  GANESH KUMAR A ME

AIR 9  AKSHAY KUMAR T EE

AIR 9  CHHAVI JAIN E&T

AIR 9  ARPIT JAIN CE

AIR 10  HEMABH TRIVEDI ME

AIR 10  RAJAT DIXIT EE

AIR 10  L KUMARI JAISWAL E&T

AIR 10  AMIT SHARMA CE

and many more...

TOTAL 36 RANKS IN TOP 10

ME 10 | EE 09 | E&T 10 | CE 07