ESE - 2025

Preliminary Examination

QUESTIONS WITH DETAILED SOLUTIONS

ELECTRICAL ENGINEERING

ACE Engineering Academy has taken utmost care in preparing the **ESE-2025** 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/IRMS/SSC/RRB/PSUs/PSC/GENCO/TRANSCO etc.,).**

All Queries related to **ESE-2025** Solutions are to be sent to the following email address **help@ace.online**

Electrical Engineering
(SET - C)

SUBJECT WISE WEIGHTAGE

S.No.	Name of the Subject	1 Mark
1	Engineering Mathematics	12
2	Electrical Materials	12
3	Electric Circuits & Fields	13
4	Electrical & Electronic Measurements	11
5	Computer Fundamentals	12
6	Basic Electronic Engineering	13
7	Analog & Digital Electronics	12
8	Systems & Signal Processing	12
9	Control Systems	13
10	Electrical Machines	13
11	Power Systems	15
12	Power Electronics	12
Total No. Of Questions		150

01. Which one of the following commutated converters is working on the principle of natural commutation?
(a) Series-parallel commutated converter
(b) Series commutated converter
(c) Parallel commutated converter
(d) Line commutated converter

01. Ans: (d)

Sol: In line commutated converter natural commutation is used.

02. In a single-phase full-wave controlled rectifier circuit with midpoint configuration, two SCRs (M-2) and
(a) an autotransformer with centre-tapped secondary windings are employed
(b) a three-phase transformer with centre-tapped secondary windings are ·employed
(c) a single-phase transformer with centre-tapped secondary windings are employed
(d) a central tapping transformer with secondary windings are employed

02. Ans: (c)

Sol: In mid point rectifier 1-ϕ transformer with centre-tapped secondary windings are employed.

03. The reverse recovery current of a power diode is 10μs and the rate of fall of current is about 200 A/μs. What is the storage charge?
(a) 10 mC (b) 100 mC
(c) 400 mC (d) 40 mC

03. Ans: (a)

Sol: $t_{rr} = \sqrt{\dfrac{2Q_{rr}}{\left(\dfrac{di}{dt}\right)}}$

$$10 \times 10^{-6} = \sqrt{\dfrac{2Q_{rr}}{\left(\dfrac{200}{10^{-6}}\right)}}$$

$$100 \times 10^{-12} = \dfrac{2Q_{rr}}{\left(\dfrac{200}{10^{-6}}\right)}$$

$$2Q_{rr} = 100 \times 10^{-12} \times \dfrac{200}{10^{-6}}$$

$$2Q_{rr} = 2 \times 10^{4} \times 10^{-6}$$

$$\therefore Q_{rr} = 10 \text{ mC}$$

04. The advantageous feature of AC drives with a current source DC link converter is
(a) speed setting range up to 1: 100
(b) high degree of motor protection
(c) reduced costs
(d) control structure more simple

04. Ans: (b)

Sol: The inherent current limiting characteristic of a CSI allows for effective protection against short circuits, minimizing damage to the drive and motor.

05. When an AC main is ON, the rectifier circuit will supply the power to the inverter as well as to the battery, therefore, it acts as a
(a) UPS system
(b) power conditioner
(c) static switch
(d) rectifier cum charger

05. Ans: (d)

Sol: In UPS rectifier supply to inverter and also it charges the battery therefore rectifier acts as rectifier and battery charger.

06, Based on the use of resonant tank, the resonant converters are classified as

1. Resonant DC link converters
2. Resonant AC link converters
3. Resonant switch converters
4. load resonant converters

Select the correct answer.

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

06. Ans: (a)

Sol: Based on use of resonant tank, resonant conveters are classified as

(i) resonant DC link converter
(ii) resonant AC link converter
(iii) resonant switch converter
(iv) Load resonant converter

07. If resonant elements are added to the DC-DC converters, then the resulting converters are known as

(a) semiconductor devices
(b) resonant switch converters
(c) component inductances
(d) multi-resonant switches

07. Ans: (b)

Sol: In DC to DC converter if resonant elements are added then it is known as resonant switch converter.

08. The resonant technique processes power in sinusoidal form. The power switches are often turned off under

(a) minimum current (b) zero current
(c) high current (d) device current

08. Ans: (b)

Sol: In resonant converter, switches are turned off under zero current and zero voltage, therefore switching loss is zero.

09. DC to DC converters basically consist of two conversion stages, namely

(a) DC to AC resonant inverters and AC to DC rectifier
(b) AC to DC resonant inverters and DC to AC rectifier
(c) DC to AC converters and AC to DC rectifier
(d) AC to DC converters and DC to AC rectifier

09. Ans: (a)

Sol: In two stage DC to DC converters, DC to AC resonant inverter and AC to DC rectifier are used.

Directions :

Each of the following **six (06)** items consists of two statements, one labeled as ‘Statement (I)’ and the other as ‘Statement (II)’. You are to examine these two statements carefully and select the answers to these items using the codes given below :

Codes:

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true

10. **Statement (I):** If the capacitance of an overhead line is high, the line draws more charging current, which compensates or cancels the lagging component of load current.

Statement (II) : The resultant current flowing in the line is reduced.

10. Ans: (a)

Sol: (i) when capacitance increases its charging current also increases.

(ii) more the capacitive current less will be the line current.

11. **Statement (I) :** Voltage control and reactive power control are interrelated and need to be therefore considered together.

Statement (II) : The voltage variation at a load is an indication of the unbalance between the reactive power generated and absorbed by that load.

11. Ans: (a)

Sol: $Q \propto \Delta|V|$

any variation in Q will lead variation in voltage.

12. **Statement (I) :** BIBO stands for Bounded Input Bounded Output. The meaning of the word 'bounded' is some finite value.

Statement (II) : A system is said to be stable, if it follows BIBO principle, i.e., every bounded input produces bounded output.

12. Ans: (a)

Sol: Statement (I) correctly defines BIBO as Bounded Input Bounded Output, emphasizing that "bounded" means a finite value.

Statement (II) accurately describes the stability condition, if a system ensures every bounded input results in a bounded output, it is considered stable.

Since both statements are individually true and Statement (II) serves as the correct explanation of Statement (I), the correct answer is (a)

13. **Statement (I):** Insulation resistance falls with increase in temperature; in some cases, there is a marked decrease in insulation resistance.

Statement (II): The resistivity of the insulator is considerably lowered in the presence of moisture.

13. Ans: (b)

Sol: (i) When temperature increases the resistance of insulators decreases (Negative temperature coefficient).

(ii) When moisture increases the leakage current increases and insulation resistance decreases.

14. **Statement (I):** A computer's control unit does not perform any actual processing of jobs, but acts as the central nervous system for other components of the computer systems.

Statement (II): It obtains instructions from a program stored in main memory, interprets the instructions and issues signals causing other units of the system to execute them.

14. Ans: (a)

Sol: Statement (II) gives correct explanation that under pins Statement (I).

15. **Statement (I):** The resistivity of ferrites is very much higher than that of ferromagnetic metals.

Statement (II): The ferrites are chemical compounds and electrons in them are subject to restraint of valence forces.

15. Ans: (a)

Sol: Ferrite is a ceramic material having very high resistivity.

Eg: $MnFe_2O_4$, $NiFe_2O_4$

Ferromagnetic materials are metals, which are good electrical conductors

Eg: Fe, Co, Ni

Statement (I) is correct

Ceramics are chemical compounds and electron flow is restricted in ceramics and hence resistivity is high. Statement (II) is also correct

Statement (II) is correct explanation for statement (I).

16. Which one of the following power plants is suitable for supplying peak loads?
(a) Nuclear power plant
(b) Steam power plant
(c) Hydropower plant
(d) Gas turbine power plant

16. Ans: (d)

Sol: Gas turbine power plant is the peak load plant

17. The specific rotational speed (N_s) for a water turbine is

(a) $\frac{N\sqrt{P_t}}{H^{2.25}}$ (b) $\frac{P_t\sqrt{N}}{H^{1.25}}$

(c) $\frac{N\sqrt{P_t}}{H^{1.25}}$ (d) $\frac{P_t\sqrt{N}}{H^{2.25}}$

where, P_t is output in metric hp

N is actual rotational speed of the turbine

H is effective head in metres

17. Ans: (c)

Sol: The specific speed of water turbine,

$$N_s = \frac{N\sqrt{P_t}}{H^{1.25}}$$

18. A steam power station of 100 MW capacity uses coal of calorific value of 6400 kcal/kg. The thermal efficiency of the station is 30% and electrical generation efficiency is 92%. When the station is working at full load, the coal required per hour will be nearly
(a) 38.3 tonnes (b) 48.7 tonnes
(c) 54.7 tonnes (d) 64.3 tonnes

18. Ans: (b)

Sol: $\eta_{overall} = \eta_t \times \eta_c = 0.3 \times 0.92$

$$\eta_{overall} = \frac{\text{Electrical Energy in kwh} \times 860}{\text{Amount of coal in kg} \times \text{calorific value in Kcal/kg}}$$

$\therefore$ Amount of coal in tonnes

$$= \frac{100 \times 1000 \times 860}{0.3 \times 0.92 \times 6400}$$

$= 48.68$ tonnes

19. The insulation resistances R_1 and R_2 of a live 2-wire network are measured by earthing each main in turn through a milliammeter in series with a high resistance r. When the supply voltage is 500 V, the values of r = 20000 Ω, i_1 = 1 mA and i_2 = 0.5 mA, the insulation resistances R_1 and R_2 respectively are
(a) 0.47 MΩ and 0.28 MΩ
(b)· 0.94 MΩ and 0.28 MΩ
(c) 0.47 MΩ and 0.47 MΩ
(d) 0.94 MΩ and 0.47 MΩ

19. Ans: (d)

ONLINE

ace online

PROGRAMMES OFFERED

Self-Paced Learning Program

Immerse yourself in a personalized and enriching learning experience, with high-quality video content delivered by India's most esteemed and highly accomplished faculty members.

Enjoy the freedom of unlimited access, allowing you to study at your convenience from any location. Take advantage of complimentary live doubt clearing sessions and an extensive online test series to elevate your exam readiness.

LIVE

Exclusive Online Live Classes

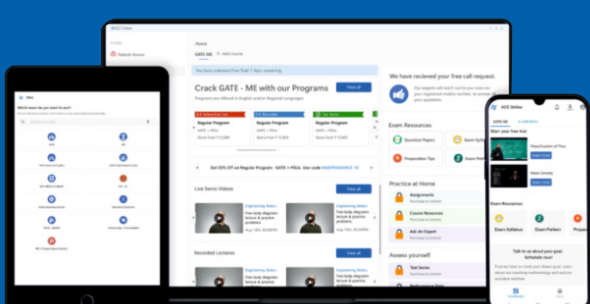
Engage in our exclusive live classes, offering an interactive learning experience from any location nationwide. Benefit from real-time guidance and the opportunity to resolve doubts directly with our esteemed faculty. Additionally, access recorded videos of the live sessions for convenient review before exams or to catch up on missed classes at your own pace.

0% No-Cost EMI Available

ESE | GATE | PSUs | SSC | RRB
& 30+ Other Exams

Streams: **CE** | **ME** | **EE** | **EC** | **CS** | **IN** | **DA**

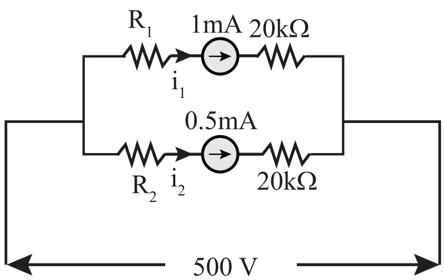
- Experienced Faculty
- Ask an Expert
- Live Doubt Clearance
- Learn with 2D & 3D Animations
- Free Online Test Series
- Full Set of Study Material



Scan QR & start your **7-DAY Free Trial!**

Download on the App Store | Get it on Google play | Download on the Windows Store

Sol:



$$i_1 = \frac{500}{R_1 + 20K} \Rightarrow R_1 + 20K = \frac{500}{1 \times 10^{-3}}$$

$$R_1 = 5000\times10^3 - 20\times10^3$$

$$= 0.48 M\Omega$$

$$i_2 = \frac{500}{R_2 + 20K} \Rightarrow R_2 + 20K = \frac{500}{0.5 \times 10^{-3}}$$

$$R_2 = 1000\times10^3 - 20\times10^3$$

$$= 0.98 M\Omega$$

No option matching

But if ammeters are placed in the other circuits then option (d) can be matched.

20. The advantages of supercritical steam power plants are

1. low grade fossil fuels can be used
2. NO_2 emissions are completely eliminated
3. SO_2 emissions are reduced and complete burning of coal occurs

Which of the above advantages are correct?

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

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

20. Ans: (c)

Sol: NO_2 and SO_2 emissions will be reduced in a super critical steam power plant.

21. A 3-phase, 10000 kVA, 11 kV alternator has a sub-transient reactance of 8%. If 3-phase short circuit occurs at its terminals, the fault power will be nearly

(a) 125 MVA (b) 135 MVA

(c) 145 MVA (d) 155 MVA

21. Ans: (a)

Sol: $MVA_{SC} = \dfrac{MVA_B}{Z''_{dpu}}$

$$= \frac{10MVA}{0.08} = 125 \text{ MVA}$$

22. The operating time t of a static time-current relay is

(a) $\dfrac{IM}{K^n - I_p^n}$ (b) $\dfrac{KM}{I^n - I_p^n}$

(c) $\dfrac{IM}{K^n + I_p^n}$ (d) $\dfrac{KM}{I^n + I_p^n}$

where, M is time multiple setting

I is multiple of tap current

I_p is multiple of tap current at which pickup occurs

n is characteristic index of the relay

K is design constant of the relay

22. Ans: (b)

Sol: The operating time of a static time current relay,

$$t = \frac{KM}{I^n - I_p^n}$$

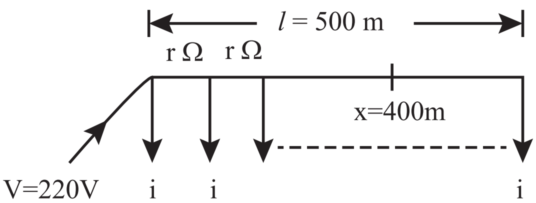
23. A uniformly distributed load on a distributor of length 500 m is rated at 1 A/m length. The distributor is fed from one end at 220 V. If the loop resistance is 2×10^{-5} Ω/m, the voltage drop at a distance of 400 m from the feeding point will be

(a) 5.2V (b) 4.2 V

(c) 3.4 V (d) 2.4 V

23. Ans: (d)

Sol:



$i = 1\,A/m$

$r = 2\times10^{-5}\,\Omega/m$

Voltage drop $V = ir\left(\ell x - \frac{x^2}{2}\right)$

$$= 1 \times 2 \times 10^{-5}\left(5000 \times 400 - \frac{400^2}{2}\right)$$

$= 2.4V$

24. Which one of the following distributors is having greater reliability and better flexibility?
 (a) Ring main distributor
 (b) Tree distributor
 (c) Radial distributor
 (d) Tapered distributor

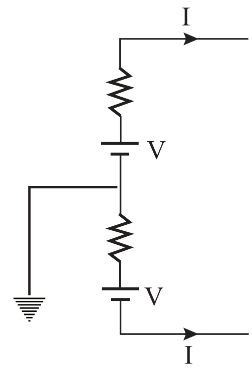
24. Ans: (a)

Sol: The Ringmain distributor is having high reliability and flexibility.

25. An existing DC three-wire system is to be converted into a 3-phase, 4-wire system by adding a fourth wire equal in cross-section to each outer wire of the DC system. For the same supply and load voltages to neutral and balanced conditions, the extra power at unity power factor that can be supplied by the AC system will be
 (a) 40% (b) 50%
 (c) 60% (d) 70%

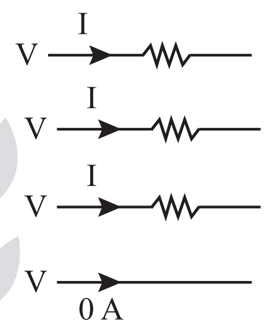
25. Ans: (b)

Sol: 3-wire DC:



$P_{DC} = 2VI$

3-ϕ, 4-wire AC:



$P_{AC} = 3.V.I\cos\phi$

$\cos\phi = 1$

$\therefore P_{AC} = 3VI$

$\therefore \frac{P_{AC}}{P_{DC}} = \frac{3VI}{2VI} = 1.5VI$

$\therefore$ 50% more

26. Which of the following statements are correct for load flow?
 1. Bus admittance matrix is the most economical from the point of view of computer time and memory requirements.
 2. The mathematical formulation of the load flow problem results in a system of non-linear equations.

3. In a power system, each node or bus is associated with four quantities.

Select the correct answer.

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

26. Ans: (d)

Sol: (i) Y_{Bus} is most economical and takes less computer memory.

(ii) The static load flow equations are of non-linear algebraic transdental equations.

(iii) At every bus there will be four variables P, Q, δ, |V|.

27. Fixed and semi-fixed costs being independent of the amount of energy generated are also called

(a) generating costs (b) operating costs
(c) running costs (d) standing costs

27. Ans: (d)

Sol: Fixed and semi-fixed costs being independent of the amount of energy generated are also called as standing costs.

28. R, L and C in an SCR circuit meant for protecting against $\frac{dv}{dt}$ and $\frac{di}{dt}$ are 4Ω, 6 μH and 6 μF respectively. If the supply voltage is 300 V,the maximum permissible value of $\frac{di}{dt}$ is

(a) 30×10^6 A/s (b) 40×10^6 A/s
(c) 50×10^6 A/s (d) 60×10^6 A/s

28. Ans: (c)

Sol: $R = 4\Omega, L = 6\ \mu H, C = 6\mu F, V_S = 300$ V

$$\text{Max.}\frac{di}{dt} = ?$$

$$V_S = L.\text{Max}\frac{di}{dt}$$

$$\therefore 300 = 6\times10^{-6}\times\left(\text{Max.}\frac{di}{dt}\right)$$

$$\therefore \text{Max}\ \frac{di}{dr} = \frac{300}{6\times10^{-6}} = 50\times10^6\ \text{A/sec}$$

29. A 3 kV, 750A power electronics circuit has thyristors with 800 V and 175 A rating. If the derating is of 25%, the number of thyristors in series will be

(a) 8 (b) 7
(c) 6 (d) 5

29. Ans: (d)

Sol: $V_{string} = 3000$ V, $I_{string} = 750$ A

SCR voltage rating = 800 V

SCR current rating = 175 A

Derating factor = 0.25

No. of SCRs in series = ?

String Efficiency = 1 – Derating factor

= 1 – 0.25 = 0.75

$$\text{String Efficiency} = \frac{V_{string}}{N_S\times \text{SCR voltage rating}}\times 100$$

$$0.75 = \frac{3000}{N_S\times 800}$$

$N_S = 5$

30. Depending on the design principles used, gating circuits are very essential to direct

(a) firing pulses to each transistor in an appropriate region of the supply cycle
(b) pulse distribution
(c) firing pulses to each thyristor in an appropriate region of the supply cycle
(d) synchronization of thyristor

30. Ans: (c)

Sol: Depending on the design principles used, gating circuits are very essential to direct firing pulses to each thyristors in an appropriate region of supply cycle.

31. A mathematical abstraction to represent or model the dynamics of a system utilizes three types of variables called
(a) time, frequency and amplitude of the input
(b) input, output and time
(c) input, output and state variables
(d) input, output and frequency

31. Ans: (c)

Sol: Dynamic systems uses 3 variable to describe in state model. That are input, output & state variable.

32. If it is possible to transfer the system state from any initial state $\mathbf{x}(t_o)$ to any other desired state $\mathbf{x}(t_r)$ in specified finite time by a control vector $\mathbf{u}(t)$, the system is said to be completely
(a) stable (b) observable
(c) state controllable (d) unstable

32. Ans: (c)

Sol: A system is said to be controllable, if it is possible to transfer initial state $\mathbf{x}(t_0)$ to any other desired state $\mathbf{x}(t_f)$ in a finite time interval by a control vector $\mathbf{u}(t)$.

33. If every state $\mathbf{x}(t_o)$ can be completely identified by measurements of the output $\mathbf{y}(t)$ over a finite time interval, the system is said to be completely
(a) "state controllable (b) observable
(c) unstable (d) stable

33. Ans: (b)

Sol: A system is said to be observable, if every state $\mathbf{x}(t_0)$ can be completely identified by measurement of the output $\mathbf{y}(t)$ over a finite time interval.

34. If the output voltage in autotransformer is less than the input voltage
(a) the load current is more than the input current
(b) the load current is less than the input current
(c) the load current becomes zero
(d) the input current becomes zero

34. Ans: (a)

Sol: As $V_2 < V_1$
Then $I_2 > I_1$

35. The maximum field circuit resistance (for a given speed) with which the shunt generator would just excite is known as its
(a) series field resistance
(b) critical field resistance
(c) shunt field resistance
(d) load field resistance

35. Ans: (b)

Sol: The max field resistance above which generator fails to build up voltage is the 'Critical field resistance'.

36. The speed at which the rotating magnetic field revolves is called
(a) asynchronous speed (b) synchronous speed
(c) constant speed (d) variable speed

36. Ans: (b)

Sol: The speed at which the rotating magnetic field revolves is called synchronous speed

37. A shunt generator is rated at 240 V full load. At no load, the voltage is 252 V. The voltage regulation will be
(a) 5% (b) 6%
(c) 7% (d) 8%

37. Ans: (a)

Sol: $\%V.Reg^{n} = \dfrac{V_{NL} - V_{FL}}{V_{FL}} \times 100$

$= \dfrac{252 - 240}{240} \times 100$

$= \dfrac{12}{240} \times 100 = 5\%$

38. When a compound generator has its series field flux aiding its shunt field flux, the machine is said to be
(a) differentially compound
(b) cumulative compound
(c) series machine
(d) shunt machine

38. Ans: (b)

Sol: In cumulative compound, the series and shunt fields will aid each other.

39. The load torque developed by synchronous motor at which the motor pulls out of the synchronism is called
(a) breakdown torque
(b) starting torque
(c) pull-in torque
(d) maximum torque

39. Ans: (a)

Sol: Breakdown torque or pull-out torque or Starting torque

40. A 6-pole, 3-phase induction motor is connected to a 50 Hz supply. If it is running at 970 r.p.m., the slip will be
(a) 3% (b) 4%
(c) 5% (d) 6%

40. Ans: (a)

Sol: P = 6, f = 50 Hz, N_r = 970 rpm

$N_s = \dfrac{120f}{P} = \dfrac{120 \times 50}{6} = 1000$ rpm

Slip, $s = \dfrac{N_S - N_r}{N_S} = \dfrac{1000 - 970}{1000} = 0.03$

$= 3\%$

41. The stator of a 3-ϕ induction motor has 3 slots per pole per phase. If the supply frequency is 50 Hz, the speed of the rotating stator flux will be
(a) 800 rpm (b) 1000 rpm
(c) 1200 rpm (d) 1500 rpm

41. Ans: (d)

Sol: For 50 Hz supply,

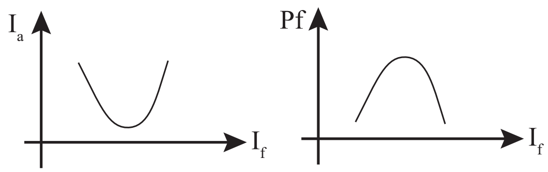
Poles (P)	Synchronous Speed (N_S)
2	3000 rpm
4	1500 rpm
6	1000 rpm
8	750 rpm

From the given option 1500 rpm is the correct answer.

42. The graph between armature current (I_a) and field current (I_f) of a synchronous motor for a constant load is called
(a) Z-curve (b) T-curve
(c) C-curve (d) V-curve

42. Ans: (d)

Sol:



43. In salient-pole machines, the resultant air gap flux is increased as in a cylindrical rotor alternator when armature reaction flux ϕ_a for $\psi = 90°$
(a) leading aids the field flux ϕ_f
(b) lagging aids the field flux ϕ_f
(c) leading opposes the field flux ϕ_f
(d) lagging opposes the field flux ϕ_f

43. Ans: (a)

Sol: Leading aids the field flux ϕ_f
When $\psi = 90°$,
ϕ_a aids ϕ_f, so that armature reaction purely magnetization.

44. A stepper motor has a step angle of 10° and is required to rotate at 200 r.p.m. The pulse rate of the motor will be
(a) 120 steps/s (b) 130 steps/s
(c) 140 steps/s (d) 150 steps/s

44. Ans: (a)

Sol: Speed, $N = \dfrac{\beta \times f}{360}$ rps, $f \rightarrow$ steps/sec

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

$f \rightarrow$ steps/sec
b $\rightarrow$ step angle

$$200 = \frac{10 \times f}{360} \times 60$$

$$f = \frac{360 \times 200}{10 \times 60} = 120 \text{ steps/sec}$$

45. A four-stack VR stepper motor has a step angle of 1.8°. The number of its rotor teeth will be
(a) 48 (b) 50
(c) 52 (d) 54

45. Ans: (b)

Sol: The step angle, $\beta = \dfrac{360}{mP_r}$
$m \rightarrow$ no. of stacks or phases = 4 (given)
$P_r \rightarrow$ rotor poles or teeths

$$1.8 = \frac{360}{4 \times P_r}$$

$$P_r = \frac{360}{1.8 \times 4} = 50$$

46. The Fourier transform of unit step function u(t) is
(a) $u(t) \leftrightarrow \pi\delta(\omega)$
(b) $u(t) \leftrightarrow \dfrac{1}{j\omega}$
(c) $u(t) \leftrightarrow \pi\delta(\omega) + \dfrac{1}{j\omega}$
(d) $u(t) \leftrightarrow \pi\delta(\omega) - \dfrac{1}{j\omega}$

46. Ans: (c)

Sol: $u(t) \longleftrightarrow \pi\delta(\omega) + \dfrac{1}{j\omega}$

47. Consider the following signals .
$x_1(t) = 10\cos(100\pi t)$; $x_2(t) = 10\cos(50\pi t)$
If both are sampled at f_s = 75 Hz, the sampled signals $x_1(n)$ and $x_2(n)$ are

OFFLINE

ACE® Engineering Academy
Leading Institute for ESE/GATE/PSUs

Classroom Coaching

- Engaging in classroom coaching provides a transformative and engaging learning experience that deeply encourages interactive student-faculty relationships within an ideal educational environment.
- By participating in our extensive classroom sessions, students not only acquire knowledge but also develop crucial skills and enhanced confidence levels that are pivotal for their success.
- ACE provides classroom coaching by experienced educators to support increased competition and participation in competitive exams.






→ ***Smart Classrooms***

→ ***Library/Reading Rooms***

→ ***Calm Study Environment***

→ ***Near to Metro Station***

→ ***Centralized AC Classrooms***

→ ***No-Cost EMI available***

H.O. @ Abids # 3rd Floor, Suryalok Complex, Rosary Convent School Road, Gun Foundry, Basheer Bagh, Hyderabad, Telangana – 500001.

B.O. @ Kothapet # 2nd floor, BAHETI SPECTRUM, Beside: Kinara Grand, Near Victoria MemorialMetro Station, Pillar No: CHPNP-32, 33, Kothapet, Hyderabad, Telangana.

(a) $10\cos\left(\frac{2\pi}{3}n\right)$ and $10\cos\left(\frac{2\pi}{3}n\right)$

(b) $\cos\left(\frac{\pi}{n}\right)$ and $2\cos\left(\frac{\pi}{n}\right)$

(c) $\cos\left(\frac{2\pi}{n}\right)$ and $\cos\left(\frac{\pi}{n}\right)$

(d) $\cos\left(\frac{2\pi}{3}n\right)$ and $\cos\left(\frac{2\pi}{3}n\right)$

47. Ans: (a)

Sol: The sampled signal $x_1(n) = x_1(t)\big|_{t=nT_s}$

$$T_s = \frac{1}{f_s} = \frac{1}{75}$$

So, $x_1(n) = 10\cos\left(100\times\pi\times n\times\frac{1}{75}\right)$

$$x_1(n) = 10\cos\left(\frac{4\pi}{3}n\right) = 10\cos\left(\left(2\pi - \frac{2\pi}{3}\right)n\right)$$

$$x_1(n) = 10\cos\left(\frac{2\pi}{3}n\right)$$

The sample signal $x_2(n) = x_2(t)\big|_{t=nT_s}$

$$x_2(n) = 10\cos\left(50\times\pi\times n\times\frac{1}{75}\right)$$

$$x_2(n) = 10\cos\left(\frac{2\pi}{3}n\right)$$

48. When the Fourier transform and inverse transform equations are similar but not quite identical, then this symmetry leads to a property called

(a) proportional
(b) multiplication
(c) convolution
(d) duality

48. Ans: (d)

Sol: From duality property,

$x(t) \leftrightarrow X(\omega)$

$X(t) \leftrightarrow 2\pi x(-\omega)$

49. Consider

$H_a(s) = \frac{1}{(s+1)^2}$ and $T = 0.1$ s

Using bilinear transformation, H(z) is

(a) $\frac{0.0476}{(1-0.9048z)^2}$
(b) $\frac{0.0476(1+z)^2}{(1-0.9048z^{-1})^2}$
(c) $\frac{0.0476}{(1-0.9048z^{-1})^2}$
(d) $\frac{0.0476(1+z^{-1})^2}{(1-0.9048z^{-1})^2}$

49. Ans: (*)

Sol: Given $H_a(s) = \frac{1}{(s+1)^2}$, $T = 0.1$ sec

$$H(z) = H_a(s)\Big|_{s=\frac{2}{T}\left[\frac{1-z^{-1}}{1+z^{-1}}\right]}$$

$$H(z) = \frac{1}{\left[\frac{2}{0.1}\left[\frac{1-z^{-1}}{1+z^{-1}}\right]+1\right]^2}$$

$$H(z) = \frac{(1+z^{-1})^2}{\left[20(1-z^{-1})+1+z^{-1}\right]} = \frac{(1+z^{-1})^2}{(21-19z^{-1})^2}$$

$$H(z) = \frac{0.00226(1+z^{-1})^2}{(1-0.9047z^{-1})^2}$$

50. Which one of the following systems can be represented by the given general difference equation?

$$y(n) = -\sum_{k=1}^{N} a_k y(n-k) + \sum_{k=1}^{N} b_k x(n-k)$$

(a) DFS
(b) CFS
(c) LTI
(d) LSF

50. Ans: (c)

Sol: The given difference equation represents a LTI system. It is a N^{th} order linear constant coefficient difference equation.

51. What is the convolution of the given two sequences?

$x(n) = e^{-n^2}$, for all n and $h(n) = 3n^2$, for all n

(a) $3.521n^2 + 1.5$ (b) $1.623n+1$

(c) 1.598 (d) $5.318n^2+2.654$

51. Ans: (d)

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

$$y(n) = \sum_{k=-\infty}^{\infty} x(k)h(n-k)$$

$$y(n) = \sum_{k=-\infty}^{\infty} e^{-k^2}[3(n-k)^2]$$

$$y(n) = \sum_{k=-\infty}^{\infty} 3n^2e^{-k^2} + \sum_{k=-\infty}^{\infty} 3k^2e^{-k^2} - \sum_{k=-\infty}^{\infty} 6nke^{-k^2}$$

$$y(n) = 3n^2[.... + e^{-1} + 1 + e^{-1} + ..] + \sum_{k=-\infty}^{\infty} 3k^2e^{-k^2} + 0$$

The value of first summation is approximately equal to "$5.318n^2$".

So, $y(n) = 5.318n^2 + 2.654$

52. For type 2 system with unit ramp input, the steady-state error e_{ss} is

(a) ∞ (b) $\frac{1}{K}$

(c) 0 (d) $\frac{1}{1+K}$

52. Ans: (c)

Sol: Type-2 system gives steady state error is zero for unit ramp input.

53. A transfer function of a linear time- invariant system is defined to be the ratio of the Laplace transform of

(a) the output variable to the Laplace transform of the input variable under the assumption that all the initial conditions are zero

(b) the input variable to the Laplace transform of the output variable under the assumption that all the initial conditions are not zero

(c) the output variable to the Laplace transform of the input variable under the assumption that all the initial conditions are not zero

(d) the input variable to the Laplace transform of the output variable under the assumption that all the initial conditions are zero

53. Ans: (a)

Sol: TF of LTI system is defined as the ratio of Laplace transform of output variable to the Laplace transform of input variable under the assumption that all the initial conditions are zero.

54. For a unity feedback control system, the forward path transfer function is given by

$$G(s) = \frac{10}{(0.5s+1)(s+5)}$$

The position and velocity error constants for this system will be respectively

(a) 2 and ∞ (b) 2 and 0

(c) 20 and ∞ (d) 20 and 0

54. Ans: (b)

Sol: $K_p = \underset{s\to 0}{Lt}\, G(s) = \underset{s\to 0}{Lt} \frac{10}{(0.5s+1)(s+5)} = \frac{10}{5} = 2$

$K_v = \underset{s\to 0}{Lt}\, sG(s) = \underset{s\to 0}{Lt}\, s\left(\frac{10}{(0.5s+1)(s+5)}\right) = 0$

55 A system is described by the differential equation

$$3\frac{d^2c(t)}{dt^2} + 5\frac{dc(t)}{dt} + c(t) = r(t) + 3r(t-2)$$

The transfer function of the system is

(a) $\frac{1+3e^{-2s}}{3s^2-5s-1}$ (b) $\frac{1-3e^{-2s}}{3s^2-5s-1}$

(c) $\frac{1+3e^{-2s}}{3s^2+5s+1}$ (d) $\frac{1-3e^{-2s}}{3s^2+5s+1}$

55. Ans: (c)

Sol: $3\frac{d^2c(t)}{dt^2}+5\frac{dc(t)}{dt}+c(t)=r(t)+3r(t-2)$

Apply LT $\Rightarrow 3s^2C(s)+5sC(s)+C(s)= R(s)+3e^{-2s}R(s)$

$C(s)[3s^2 + 5s + 1] = R(s)[1+3e^{-2s}]$

$$\frac{C(s)}{R(s)}=\frac{(1+3e^{-2s})}{(3s^2+5s+1)}$$

56. The steady-state errors for type 1, type 2 and type 3 systems with parabolic input are respectively

(a) infinite, constant value and zero
(b) constant value, infinite and zero
(c) infinite, zero and constant value
(d) constant value, zero and infinite

56. Ans: (a)

Sol:

Type	Input	e_{ss}
1	Parabolic	∞
2	Parabolic	Constant
3	Parabolic	0

57. The Laplace transform of the function

$$f(t) = t^n e^{-at}$$

is

(a) $\frac{n!}{(s+a)^{n+1}}$ (b) $\frac{n!}{(s-a)^{n-1}}$

(c) $\frac{n!}{(s+a)^{n-1}}$ (d) $\frac{n!}{(s-a)^{n+1}}$

57. Ans: (a)

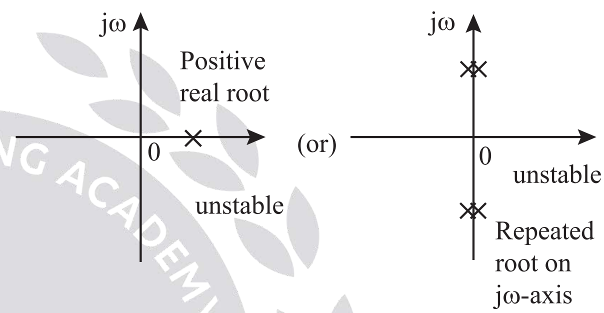
Sol: $L[t^n.e^{-at}]=\frac{n!}{(s+a)^{n+1}}$

58. If any root of the characteristic equation has a positive real part or if there is a repeated root on the jω-axis, the system is

(a) conditionally stable (b) limitedly stable
(c) stable (d) unstable

58. Ans: (d)

Sol:



59. Consider the unity feedback system given by

$$G(s)=\frac{1}{(s+1)^2}$$

The phase margin is

(a) 0° (b) 45°
(c) 120° (d) 180°

59. Ans: (d)

Sol: $PM = 180^\circ + \angle G(j\omega)\big|_{\omega_{gC}}$

$\xrightarrow{\omega_{gc}} |G(j\omega)| = 1$

$\frac{1}{(\sqrt{\omega^2+1})^2}=1 \Rightarrow (\omega^2+1)=1$

$\Rightarrow \omega_{gc} = 0$ rad/sec

$PM = 180-2\tan^{-1}(\omega)\big|_{\omega_{gc}=0} = 180^\circ$

60. For the system having open-loop transfer function

$$G(s)\,H(s)=\frac{K}{s(s+2)(s+3)}$$

the breakaway point is nearly

(a) –0.245 (b) –0.785
(c) –1.585 (d) –3.345

60. Ans: (b)

Sol: $G(s)H(s) = \dfrac{K}{s(s+2)(s+3)}$

BP: $\dfrac{d}{ds}\left(\dfrac{1}{s^3+5s^2+6s}\right) = 0$

$0 - 1(3s^2 + 10s + 6) = 0$

$s = -0.785$

61. A carrier signal having 10 V peak amplitude is amplitude modulated by three different modulating frequencies with peak amplitude levels of 2 V, 3 V and 4 V respectively. The modulation index of the resultant complex AM signal will be nearly

(a) 0.44 (b) 0.54
(c) 0.62 (d) 0.72

61. Ans: (b)

Sol: $\mu_1 = 0.2$

$\mu_2 = 0.3$

$\mu_3 = 0.4$

$\mu_t = \sqrt{\mu_1^2+\mu_2^2+\mu_3^2}$

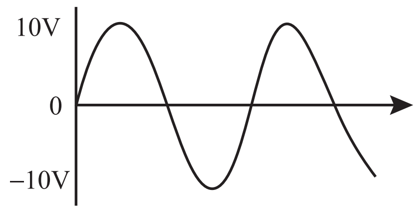
$= \sqrt{0.29} = 0.538$

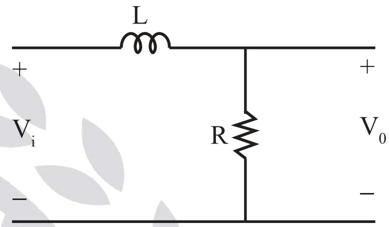
62. An AC signal having constant amplitude of 10 V, but variable frequency is applied across a simple low-pass R-L circuit with a cut-off frequency of 1 kHz. If R is 1 kΩ, the value of L will be nearly

(a) 130 mH (b) 140 mH
(c) 150 mH (d) 160 mH

62. Ans: (d)

Sol:





Cut-off frequency = 1 kHz

R = 1000 Ω

L = ______

$f_c = \dfrac{R}{2\pi L} \Rightarrow L = \dfrac{R}{2\pi f_c}$

$L = \dfrac{1000}{2\pi(1000)} = \dfrac{1}{2\pi}$

$L = 0.159 \Rightarrow 159$ m H ≈ 160 mH.

63. It is desired to design a microcontroller based periodic signal generator with minimum and maximum time period specifications of 125 ns and 100 ms. Then the system clock frequency will be

(a) 8 MHz (b) 10 MHz
(c) 12 MHz (d) 14 MHz

63. Ans: (a)

Sol: $T_{min} = 125$ ns; $T_{max} = 100$ ns

$f_{max} = \dfrac{1}{T_{min}} = \dfrac{1}{125\times10^{-9}} = 8$ MHz

$f_{min} = \dfrac{1}{T_{amx}} = \dfrac{1}{100\times10^{-3}} = 10$ Hz

The system clock frequency must be at least equal to the maximum frequency requirement, i.e., 8 MHz

64. An amplitude modulated amplifier has a radio frequency output of 50 W at 100% modulation. If the internal loss in the modulator is 10 W, the unmodulated carrier power will be

(a) 10 W (b) 20 W
(c) 30 W (d) 40 W

64. Ans: (d)

Sol: $P_t = 50 + 10 = 60$ W

$P_t = P_C\left(1+\frac{\mu^2}{2}\right)$

$60 = P_C\left(1+\frac{1}{2}\right)$

$\therefore P_C = 40$ W

65. The maximum deviation allowed in an FM broadcast system is 75 kHz. If the modulating signal is a single-tone sinusoid of 10 kHz, the bandwidth of the FM signal will be

(a) 140 kHz (b) 150 kHz
(c) 160 kHz (d) 170 kHz

65. Ans: (d)

Sol: $\beta = \frac{\Delta P_{max}}{f_{max}} = \frac{75\times10^3}{10\times10^3} = 7.5$

$BW = 2[\beta + 1]f_{max}$

$= 2[8.5] \times 10 \times 10^3$

$= 170$ kHz

66. The Peak Envelope Power (PEP) in suppressed carrier signal is

(a) $\frac{V_P^2}{2R_L}$ (b) $\frac{2V_P^2}{R_L}$
(c) $\frac{V_P^2}{R_L}$ (d) $\frac{2V_P^2}{R_L^2}$

where, V_p is peak signal voltage
R_L is load resistance

66. Ans: (c)

Sol: $\text{Peak Envelope power} = \frac{(\text{Peak Envolope Voltage})^2}{\text{Load Resistance}}$

67. An open-circuit noise voltage generated across a 100 kΩ resistor over a frequency range of direct current to 20 kHz at room temperature of 25 °C will be nearly

(a) 4.9 μV (b) 5.7 μV
(c) 6.5 μV (d) 7.3 μV

67. Ans: (b)

Sol: $V = \sqrt{4RKTB}$

$V = \sqrt{4\times20\times10^3\times1.38\times10^{-23}\times298\times100\times10^3}$

$= 5.7\ \mu V$

68. A voice signal band limited to 3.4 kHz is sampled at 8 kHz and pulse code using 64 quantization modulated levels. If ten such signals are time division multiplexed using one 5-bit synchronizing word, the minimum channel bandwidth will be

(a) 410 kHz (b) 520 kHz
(c) 430 kHz (d) 340 kHz

68. Ans: (b)

Sol: N = 10; n = 6

$r_b = (N_n + EB)f_s$

$r_b = 520$ kbps

If Rectangular pulses used

$BW = r_b = 520$ kHz

If sync pulses are used

$BW_{min} = \frac{r_b}{2} = 260$ (kHz) (not given)

69. Six analog information signals, each band limited to 4 kHz, are required to be time division multiplexed and transmitted by a TDM system. The minimum transmission bandwidth of the PAM/TDM channel will be

(a) 40 kHz (b) 32 kHz
(c) 24 kHz (d) 16 kHz

69. Ans: (c)

Sol: N = 6

$f_s = 8$ kHz

n = 1 (standard value)

$$BW_{min} = \frac{Nnf_s}{2} = \frac{6 \times 8 \times 10^3 \times 1}{2} = 24 \text{ kHz}$$

70. By applying the time-shifting property, what is the z-transform of the following signal?

$$X(z) = \frac{z^{-1}}{1-3z^{-1}}$$

(a) $x(n) = (3)^{n+1} . u(n+1)$
(b) $x(n) = (3)^{n-1} . u(n+1)$
(c) $x(n) = (3)^{n+1} .u(n-1)$
(d) $x(n) = (3)^{n-1} . u(n-1)$

70. Ans: (d)

Sol: $X(z) = \frac{z^{-1}}{1-3z^{-1}}$

$$(3)^n u(n) \longleftrightarrow \frac{1}{1-3z^{-1}}$$

$$(3)^{n-1} u(n-1) \longleftrightarrow \frac{z^{-1}}{1-3z^{-1}} [x(n-n_0) \longleftrightarrow z^{-n_0}.X(z)]$$

So, $x(n) = (3)^{n-1}. u(n-1)$

71. The relationship between the unit step and delta function is

(a) $\int u(t)dt = \delta(t)$ (b) $\int \delta(t)dt = r(t)$
(c) $\int r(t)dt = r(t)$ (d) $\int \delta (t)dt = u(t)$

71. Ans: (d)

Sol: $u(t) = \int \delta(t)dt$

72. Which one of the following time signals is said to be periodic with period T_p for which the signal is advanced in time and hence it remains unchanged?

(a) Even (b) Odd
(c) Continuous (d) Discrete

72. Ans: (c)

Sol: Continuous time signal is said to be periodic with period 'T_p' for which the signal is advanced and remains unchanged. $x(t + T_p) = x(t)$.

73. Consider a continuous-time system with input x(t) and output y(t) :

$$y(t) = x(\sin t)$$

The system is

(a) causal (b) non-causal
(c) invertible (d) time-variant

73. Ans: (b & d)

Sol: $y(t) = x(\sin(t))$

$y(-\pi) = x(0)$

Present output depends on Future input

So, Non-causal system.

$\Rightarrow$ TIV/TV

$y_1(t) = x[\sin(t) - t_0]$

$y(t-t_0) = x[\sin(t-t_0)]$

$y_1(t) \neq y(t-t_0)$

Time variant system.

74. In the Fourier series representation, the condition for the even symmetry is

(a) $x(t) = x(-t)$ (b) $x(t) = -x(-t)$

(c) $x(t) = -x\left(t+\frac{T}{2}\right)$ (d) $x(t) = x\left(t+\frac{T}{2}\right)$

74. Ans: (a)

Sol: The condition for even symmetry is $x(-t) = x(t)$

75. Consider that the signal $x_a(t) = 10\cos 2\pi(1000)t + 5\cos 2\pi(5000t)$ is to be sampled. The Nyquist rate is

(a) 5 kHz (b) 10 kHz

(c) 15 kHz (d) 20 kHz

75. Ans: (b)

Sol: $f_1 = 1000$, $f_2 = 5000$

$f_m = \max(f_1, f_2) = 5000$

Nyquist rate $= 2f_m$

$= 10000$ Hz $= 10$ kHz.

76. The leakage current I_{CEO} from collector to emitter with the base lead open in common-emitter configuration is

(a) $I_{CO}(1+\beta_{DC})$ (b) $I_{CO}(1+\alpha_{DC})$

(c) $I_{CO}(1-\beta_{DC})$ (d) $I_{CO}(1-\alpha_{DC})$

where, I_{CO} is leakage current from collector to base with the emitter open

α_{DC} is DC current gain in common-base configuration

β_{DC} is DC current gain in common-emitter configuration

76. Ans: (a)

Sol: $I_{CEO} = (1+\beta_F)\, I_{CBO}$

Since $I_{CBO} \cong I_{CO}$

$\Rightarrow I_{CEO} = (1+\beta_F)\, I_{CO}$ where $\beta_F = \beta_{dc}$

77. Which one of the following represents the level of energy of the valence electrons of an atom bound under the effect of electromagnetic force between the electrons and nucleus?

(a) VB (b) CB

(c) EC (d) EB

77. Ans: (a)

Sol: Since the valance band represents the range of energy levels occupied by valence electrons in an Atom.

78. Ripple is the variation of output voltage about DC which is

(a) quite small in a half-rectified wave

(b) same in a half-rectified wave

(c) quite large in a half-rectified wave

(d) same in a full-rectified wave

78. Ans: (c)

Sol: As we know Ripple in a rectifier is AC component present in DC output.

$\therefore$ It is small in Full wave rectified output.

It is quite large in Half wave rectified output.

79. The rise time of certain amplifier is 35 ns. What is the approximate bandwidth of the amplifier?

(a) 10 MHz (b) 35 MHz

(c) 28.5MHz (d) 1 MHz

79. Ans: (a)

Sol: Since $BW \propto \frac{1}{\text{Rise time}} \Rightarrow B.W = \frac{0.35}{\text{Rise time}}$

$\Rightarrow BW \cong \frac{0.35}{35\text{n sec}} = \frac{0.35}{35\times 10^{-9}} \cong 10^7\text{Hz}$

$\Rightarrow BW = 10$ MHz

80. For JFET, I_{DSS} = 6 mA, V_p = –4.5 V and V_{GS} = –2 V. The value of I_D will be nearly

(a) 0.9 mA (b) 1.9 mA

(c) 2.7 mA (d) 3.7 mA

80. Ans: (b)

Sol: $I_{DSS} = 6mA$

$V_p = -4.5V$

$V_{GS} = -2V$

As, $I_D = I_{DSS}\left[1-\frac{V_{GS}}{(V_{GS})_{off}}\right]^2 = 6m\left[1-\frac{-2}{-4.5}\right]^2$

$= 6m\,[1-0.44]^2$

$= 6m\,[0.556]^2$

$\therefore I_D \cong 1.854$ mA

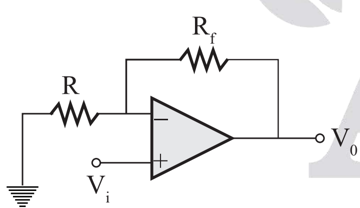
81. If the feedback network is purely resistive, then negative feedback is introduced as feedback voltage V_f and output voltage V_0 are in phase, and such amplifier is called

(a) summing amplifier (b) inverting amplifier

(c) non-inverting amplifier (d) integrator amplifier

81. Ans: (c)

Sol: From given data, the circuit could be,



$\rightarrow$ Non inverting amplifier

82. Which one of the following amplifiers transmits the input to the output terminals and is used as a buffer amplifier?

(a) Common-emitter amplifier

(b) Common-base amplifier

(c) Common-collector amplifier

(d) Common-source amplifier

82. Ans: (c)

Sol: From data, we can use common collector (emitter follower) as buffer amplifier.

(It has high impedance at input and low impedance at output).

83. In the low-frequency range, the gain is influenced by the coupling capacitor C_c. The amplifier behaves like an

(a) R-C high-pass filter (b) R-C low-pass filter

(c) R-C all-pass filter (d) R-C notch filter

83. Ans: (a)

Sol: External capacitor limit low frequencies & reduce gain at low frequencies.

$\Rightarrow$ behaves as high pass filer.

84. The word 'hybrid' in h-parameters indicates that

(a) the units of four parameters are same

(b) the units of four parameters are hybrid and do not belong to one physical quantity

(c) the parameters are used in transmission line theory

(d) the parameters are used in different types of amplifiers

84. Ans: (b)

Sol: Hybrid $\rightarrow$ Refers to the fact that these parameters have different units & not all of which belong to one physical quantity.

85. An amplifier has an open-loop gain of 1000. This gain varies by ±100, and feedback is introduced to ensure that the voltage gain varies by not more than ±0.1%. The gain with feedback A_F will be

ACE Interview Guidance Program

Empowering Job Seekers to Succeed

- Job seekers confront a variety of challenges on their path to securing a job. Our ACE Interview Guidance programme has been carefully designed to provide thorough assistance in overcoming these challenges.

- With a team of seasoned experts at the helm, our focus is on empowering individuals with the intricate skills and extensive knowledge required to fully shine during interviews.

- Whether it's perfecting your presentation strategies or fine-tuning your overall interview skills, we are completely committed to improving your prospects of securing desired positions.

- ACE conducts comprehensive mock interviews with expert panel members, both in person and virtually. These simulations are designed to thoroughly prepare individuals for college admissions or job interviews.

ACE YOUR INTERVIEWS WITH OUR EXPERT GUIDANCE!

(a) 5 (b) 10
(c) 15 (d) 20

85. Ans: (b)

Sol: Given A = 1000

$$\text{As } \%\frac{dA_f}{A_f} = \frac{\%\frac{dA}{A}}{1+\beta A}$$

$$\Rightarrow \frac{1}{1+\beta A} = \frac{dA_f/A_f}{dA/A}\text{, Given, } dA = \pm 100$$

$$\frac{dA_f}{A_f} = \pm 0.1\%$$

$$\Rightarrow \frac{1}{1+\beta A} = \frac{0.1}{100/1000} = 0.01$$

$$\Rightarrow 1+\beta A = 100$$

$$\Rightarrow \beta A = 99$$

$$\text{As } A_f = \frac{A}{1+\beta A} = \frac{1000}{100} = 10$$

86. In L-C oscillators, radio frequency choke (RFC) is used
(a) to produce high frequency
(b) to provide stability to oscillator
(c) to prevent high-frequency current flowing through the power supply
(d) to provide positive feedback

86. Ans: (c)

Sol: RFC is mainly used to prevent high frequency current from flowing through power supply.
[∵ RFC act as high impedance to high frequency signals]

87. A sinusoidal oscillator is an amplifier with
(a) negative feedback and does not require any input
(b) negative feedback and does not require any active device
(c) positive feedback and does not require any input
(d) positive feedback and does not require any active device

87. Ans: (c)

Sol: A Sinusoidal oscillator is an amplifier with positive feed back & does not required any input.

88. The output signal of an op-amp with a slew rate of 2 V/μs has a maximum value of 10 V. The maximum frequency for undistorted output voltage will be nearly
(a) 32 kHz (b) 36 kHz
(c) 42 kHz (d) 46 kHz

88. Ans: (a)

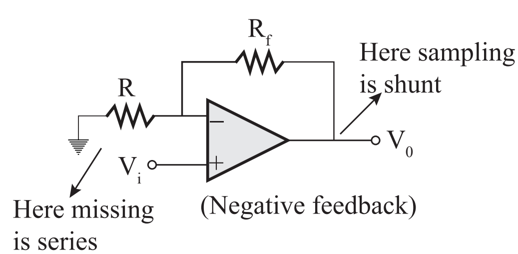
Sol: Since, $f_{max} = \dfrac{\text{slew rate}}{2\pi V_m}$

$$\Rightarrow f_{max} = \frac{2\times 10^6}{2\pi \times 10} \cong 32\text{kHz}$$

89. Non-inverting amplifier with feedback exhibits the characteristics of the perfect
(a) current amplifier
(b) voltage amplifier
(c) current-to-voltage converter
(d) voltage-to-current converter

89. Ans: (b)

Sol:



$\Rightarrow$ Voltage series feed back

$\Rightarrow$ Voltage amplifier.

90. For a 12-bit A/D converter of an input clock frequency of 1 MHz, the maximum conversion required time will be nearly

(a) 2 ms (b) 4 ms

(c) 6 ms (d) 8 ms

90. Ans: (d)

Sol: n = 12

$f_{clk} = 1$ MHz

$T_{clk} = 1\ \mu s$

The maximum conversion is for dual slope type A/D as it is the slowest and the conversion time for n bits is $= (2^{n+1} - 1)T_{clk}$

$= (2^{12+1} - 1)\ 1\ \mu s$

$= (12^{13} - 1)\ 1\ \mu s$

$= (8191)\ 1\ \mu s$

$= 8.191$ ms

≈ 8 ms

91. The output voltage of LVDT is 1.5 V at maximum displacement. At a load of 0.5 MΩ, the deviation from linearity is maximum and it is +0.003 V from a straight line through origin. The linearity at the given load will be

(a) ±0.1% (b) ±0.2%

(c) ±0.3% (d) ±0.4%

91. Ans: (b)

Sol: $\%\text{Linearity} = \dfrac{\text{Maximum deviation}}{\text{Maximum output voltage}} \times 100$

$$= \frac{0.003}{1.5} \times 100 = \pm 0.2\%$$

92. Force-summing devices are used

(a) to add different forces

(b) to convert the applied force into displacement

(c) to measure forces

(d) to convert the displacement into force

92. Ans: (b)

Sol: Force-summing devices primarily convert the applied force into displacement. They act as primary transducers, transforming pressure into mechanical movement, which can then be measured using secondary transducers.

93. Which one of the following can act as inverse transducer, when a voltage is applied across its surfaces?

(a) Electrical resistance potentiometer

(b) LVDT

(c) Capacitive transducer

(d) Piezoelectric crystal

93. Ans: (d)

Sol: An inverse transducer converts an electrical quantity into a non-electrical quantity. Among the given options, the piezoelectric crystal is the correct answer. When a voltage is applied across its surfaces, it generates mechanical deformation, making it an inverse transducer.

94. What is the full form of the following expression?

$$Y = \Pi M(0,1,3,4)$$

(a) $(A+B+C)(A+B+\overline{C})(A+\overline{B}+\overline{C})(\overline{A}+B+C)$

(b) $(\overline{A}+B+C)(A+\overline{B}+C)(A+B+\overline{C})(\overline{A}+B+C)$

(c) $(A+B+C)(A+\overline{B}+\overline{C})(A+\overline{B}+\overline{C})(\overline{A}+B+\overline{C})$

(d) $(A+B+\overline{C})(A+B+\overline{C})(A+\overline{B}+\overline{C})(\overline{A}+B+C)$

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

ace online
(A Digital Initiative by ACE Engineering Academy)

HEARTY CONGRATULATIONS TO OUR STUDENTS SELECTED IN TGPSC-AEE (2022)

Rank 1 (EE)

KAVYA NALLA
CLASSROOM COACHING
Selected in: Transport, R&B Dept., Govt. of TG.

RANK 1 CE
Venkat Reddy
MEGA MOCK TEST
Selected in Public Health, MA & UD Dept. Govt. of TG.

RANK 3 EE
Devarakonda Sathwik
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 4 EE
Sangem Ravi Kumar
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 4 CE
Makam Jeevan Kumar
CLASSROOM COACHING
Selected in Public Health, MA & UD Dept., Govt. of TG.

RANK 6 CE
Balraj Madgan
MEGA MOCK TEST
Selected in Transport, R&B Dept., Govt. of TG.

RANK 7 EE
Challabotla Saikiran
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 7 ME
Vineetha Boddula
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 7 CE
Rama Krishna
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 8 CE
Abhinav Karimilla
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 9 EE
Ganapathi G
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 9 CE
Pranay V
CLASSROOM COACHING
Selected in Public Health, MA & UD Dept., Govt. of TG.

RANK 11 EE
Sainath
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 11 CE
Bhugolla Surya Teja
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 12 EE
Veligeti Umesh
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 12 CE
Puli Naveen Reddy
CLASSROOM COACHING
Selected in Transport, R&B Dept., Govt. of TG.

RANK 14 ME
Ravi Teja
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 15 ME
M Dheeraj Reddy
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 16 EE
Jangili Rajashekar
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 18 EE
Malka Kiran
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 19 EE
Sowmya
CLASSROOM COACHING
Selected in Irrigation & CAD Dept., Govt. of TG.

RANK 20 CE
Md. Azmatullah
MEGA MOCK TEST
Selected in Transport, R&B Dept., Govt. of TG.

AND MANY MORE...

500+ SELECTIONS

CE : 434 | EE : 61 | ME : 20

94. Ans: (a)

Sol:

Index (Decimal)	Index (Binary)	Standard Max term
0	000	$A + B + C$
1	001	$A + B + \bar{C}$
3	011	$A + \bar{B} + \bar{C}$
4	100	$\bar{A} + B + C$

$y = \Pi M(0, 1, 3, 4)$

$= (A+B+C)(A+B+\bar{C})(A+\bar{B}+\bar{C})(\bar{A}+B+C)$

95. Which one of the following operators replaces certain statements of the if-then-else form in C/C++?

(a) Operator (b) Operator

(c) & Operator (d) ? Operator

95. Ans: (d)

Sol: In C/C++ we can replace the if then else certain statements by using conditional operation

The conditional/ternary operator is"?"

96. The necessary steps that the processor has to carry out for fetching an instruction from the memory and executing it, constitute

(a) an interrupt (b) an addressing

(c) an instruction cycle (d) a control signal

96. Ans: (c)

Sol: The instruction cycle is the sequence of steps that a processor performs to fetch an instruction from memory and execute it. The instruction cycle includes.

Fetch, decode, execute, store.

97. The total storage capacity of a floppy disk having 80 tracks and storing 128 bytes/sector is 163840 bytes. How many sectors does the disk have?

(a) 18 (b) 16

(c) 14 (d) 12

97. Ans: (b)

Sol: No. of tracks T = 80

No. of bytes per sector = 128 bytes

Total storage capacity = 163840 byes

No. of surfaces, H = 1

no. of sectors per track, s = ?

Total storage capacity = H * T * S * B

163840 = 1* 80 * s * 128

$$S = \frac{163840}{128 * 80} = 16$$

$\therefore$ No. of sectors per disk = 16.

98. Which one of the following buses is used to control the access to and use of data and address buses by various units which share the bus in a computer system?

(a) Data bus (b) Address bus

(c) Power bus (d) Control bus

98. Ans: (d)

Sol: Control bus is used to control the access to and used of data and address buses by various units that shares the bus in a computer system.

99. If at time t_0 the address from which data is to be retrieved is placed in MAR and at time t_1, the required data is available in MDR, the elapsed time $(t_1 - t_0)$ is called

(a) cycle time of the memory

(b) write time of the memory

(c) read time of the memory
(d) access time of the memory

99. Ans: (d)

Sol: At time t_0, the address is placed in MAR.
At time t_1, the address is placed in MAR.
At time t_1, the data becomes available in MDR
Then the elapsed time $(t_1 - t_0)$ is known as the access time of the memory.

100. In TFT LCD monitor, TFT stands for
(a) Thick Film Transistor
(b) Thin Film Transistor
(c) Time Film Transistor
(d) Through Film Transistor

100. Ans: (b)

Sol: TFT stands for thin film transistor.

101. Which one of the following is the low-level software that schedules tasks, allocates storage, and handles the interface to peripheral hardware?
(a) DMA (b) CPU
(c) I/O device (d) Kernel

101. Ans: (d)

Sol: OS is responsible to share the hardware resources efficiently among the user programs.

102. Which one of the following is used for generation of an accurate time delay for event counting, rate generation, complex waveform generation applications?
(a) Programmable timer/counter
(b) DMA controller
(c) Match coprocessor
(d) Programmable interrupt controller

102. Ans: (a)

Sol: A programmable timer/counter is specifically designed to generate accurate time delays.
(b) DMA controller is used for direct memory access
(c) Match co-processor is not typically associated with delay or wave form generation
(d) programmable interrupt controller is used to manage the interrupts.

103. The wrapping-up of data and functions into a single unit is known as
(a) encapsulation (b) abstraction
(c) inheritance (d) polymorphism

103. Ans: (a)

Sol: Encapsulation is a fundamental concept that involves bundling the data and the methods that operate on that data into a single unit known as class.

104. Which one of the following file operations is used with random access files to first position read/write pointer to a specific place in file so that the data can be read from, or written to that position?
(a) Read (b) Write
(c) Seek (d) Set attribute

104. Ans: (c)

Sol: By using seek operation in files we can random access files to first position read/write pointer to a specific place in file so that the data can be read from or written to that position.

Hearty Congratulations

To our students CIVIL ENGINEERING Selected in SSC JE - 2024


HARSHIT KHARE
Roll No. 3008100089
Selected in: **CPWD**


RAMSWRUP
Roll No. 2404100567
Selected in: **CPWD**


LAKSHIT BHARDWAJ
Roll No. 3206106390
Selected in: **CPWD**


M V SIVA RAM REDDY
Roll No. 8008101372
Selected in: **CPWD**


RAVINDRA DHAKAD
Roll No. 6005100485
Selected in: **CPWD**


RAHUL KUMAWAT
Roll No. 2401100340
Selected in: **CPWD**


VISHAL SINGH
Roll No. 3013105309
Selected in: **MES**


S R JAFFER SHARIEF
Roll No. 8006102160
Selected in: **MES**


BEHARA SRIKANTH
Roll No. 8007102883
Selected in: **MES**


ANIRUDH KOTIYAL
Roll No. 2003101448
Selected in: **MES**


FAIZAN AHMAD
Roll No. 3010108428
Selected in: **MES**


AMBATI NAGA SRI SAI
Roll No. 8601105973
Selected in: **MES**


BHASKAR SHARMA
Roll No. 2201112287
Selected in: **MES**


SRINI VASA RAO
Roll No. 8601101840
Selected in: **MES**


PIJUSH AKHULI
Roll No. 4426100222
Selected in: **MES**


ABHIMANU KUMAR
Roll No. 3205100298
Selected in: **MES**


NIMESH SINGH
Roll No. 2201114868
Selected in: **MES**


LALAM RAMU NAIDU
Roll No. 8601102319
Selected in: **MES**


GYANENDRA KUMAR
Roll No. 2201110803
Selected in: **CWC**


ADARSH AGRAHARI
Roll No. 3003100031
Selected in: **BRO**


REDDI SANNIBABU
Roll No. 8007102353
Selected in: **MES**


KONAPALA MANOJ
Roll No. 2201109855
Selected in: **MES**


SUNIL SHARMA
Roll No. 4415100648
Selected in: **MES**


RINKESH KUMAR
Roll No. 6204103361
Selected in: **MES**

& many more..

Total 150+ Selections | **CE-98** | **EE-29** | **ME-24**

105. Which one of the following not only translates the code into machine language but also executes it?
(a) Interpreter (b) Linker
(c) Loader (d) Compiler

105. Ans: (a)

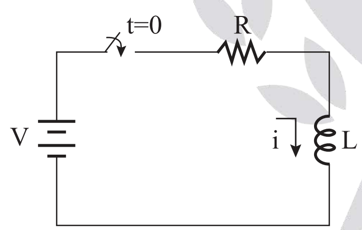
Sol: An interpreter executes the code line by line, translating each line as it runs and providing immediate feedback.

106. When a series R-L circuit is connected to a voltage V at t = 0, the current passing through the inductor L at $t = 0^+$ is
(a) $\frac{V}{R}$ (b) ∞
(c) 0 (d) $\frac{V}{L}$

where, V is voltage applied
R is resistance
L is inductor

106. Ans: (c)

Sol:



$i(0^-) = 0$
$i(0^+) = 0$
→ Inductor will not allow sudden change in current through it.

107. Which of the following statements for a balanced 3-phase circuit are correct?
1. The total instantaneous power p = 3P, where P is the real power per phase.
2. The sum of three currents at any instant is zero.
3. The sum of instantaneous reactive powers is zero.

Select the correct answer.
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

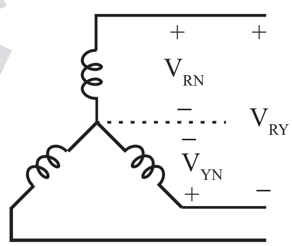
107. Ans: (a)

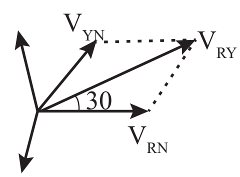
Sol: 3-ϕ balanced supply:
1) P = 3P
2) $\overline{I_R} + \overline{I_Y} + \overline{I_B} = 0$
3) $Q_{net} \neq 0$ [depends upon Load]
1 & 2 are correct.

108. In a 3-phase balanced star-connected system, the line voltages are
(a) 90° ahead of their respective phase voltages
(b) 90° behind their respective phase voltages
(c) 30° ahead of their respective phase voltages
(d) 30° behind their respective phase voltages

108. Ans: (c)

Sol: 3- ϕ Balanced star - connected system
$V_L = \sqrt{3}\, V_{ph}$
& V_L leads V_{ph} by 30° in a +ve sequence system





$$+V_{RY} + V_{YN} - V_{RN} = 0$$
$$V_{RY} = V_{RN} - V_{YN}$$

109. Which of the following conditions for a 2-port symmetrical electrical network are correct? (Assume standard notations)

1. $y_{11} = y_{22}$
2. $A = D$
3. $h_{11} = h_{22}$

Select the correct answer.

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

109. Ans: (a)

Sol: Condition for symmetric

$\boxed{z}$: $z_{11} = z_{22}$

$\boxed{y}$: $y_{11} = y_{22}$

$\boxed{h}$: $(h_{11}h_{22} - h_{12}h_{21}) = 1$

$\boxed{\begin{matrix} A & B \\ C & D \end{matrix}}$: $A = D$

(1) & (2) only correct.

110. Consider the following network function:

$$H(s) = \frac{10s}{(s^2 + 300s + 10^6)}$$

The quality factor Q is

(a) 5.3 (b) 4.7
(c) 3.3 (d) 2.7

110. Ans: (c)

Sol: $s^2 + 2\xi\,\omega_n s + \omega_n^2 = 0$

$s^2 + 300s + 10^6 = 0$

$\omega_n^2 = 10^6 \rightarrow \omega_n = 1000$ rad/sec

$2\xi\,\omega_n = 300$

$$\xi = \frac{300}{2000}$$

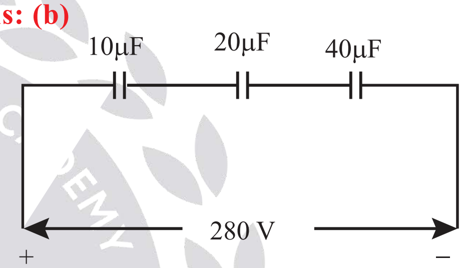
$$Q_0 = \frac{1}{2\xi} = \frac{1}{2\left[\frac{300}{2000}\right]} = \frac{1000}{300} = 3.3$$

111. Three capacitors of capacitances 10 μF, 20 μF and 40 μF are connected in series across 280 V. The charge of each capacitor will be

(a) 0.6×10^{-3} C (b) 1.6×10^{-3} C
(c) 2.6×10^{-3} C (d) 3.6×10^{-3} C

111. Ans: (b)

Sol:



$$\frac{1}{C_T} = \frac{1}{10\mu} + \frac{1}{20\mu} + \frac{1}{40\mu}$$

$$= \frac{1}{10\mu}\left[\frac{1}{1} + \frac{1}{2} + \frac{1}{4}\right]$$

$$q_T = \frac{40}{7}\mu F$$

$$q_T = C_T.V = \frac{40}{7}\mu F \times [280]\ V$$

$$q_T = 1600\mu C$$

$$q_T = 1.6 mC.$$

112. Which one of the following standards is used to check and calibrate laboratory instrument for accuracy and performance?

(a) International standard
(b) Voltage standard
(c) Working standard
(d) Secondary standard

112. Ans: (a)

Sol: International standards, maintained by organizations like BIPM, serve as the highest level of measurement standards. They ensure the accuracy and reliability of laboratory instruments by forming the base of the traceability chain. While working and secondary standards are used in routine calibration, all measurements ultimately trace back to international standards.

113. The expected value of the voltage across a resistor is 80 V. However, the measurement gives a value of 79 V. The percentage of accuracy will be nearly
(a) 92.75% (b) 94.25%
(c) 96.25% (d) 98.75%

113. Ans: (d)

Sol: $A_m = 79$ V; $A_t = 80$ V

$$\%\varepsilon = \frac{79-80}{80} \times 100 = -1.25\%$$

%Accuracy = 100 – 1.25%

= 98.75%

114. A meter will give a lower indication the voltage drop that actually existed before the meter was connected. This effect is called
(a) inductive effect of an instrument
(b) synchronizing effect of an instrument
(c) loading effect of an instrument
(d) capacitive effect of an instrument

114. Ans: (c)

Sol: This is the error due to internal resistance of the meter. It is the loading effect of an instrument.

115. The basic permanent magnet moving coil (PMMC) mechanism is often called
(a) d'Arsonval movement
(b) G Arsonval movement
(c) current sensitivity
(d) voltage sensitivity

115. Ans: (a)

Sol: The basic PMMC mechanism is often called D'Arsonval movement.

116. In frequency division multiplexing, a typical telemetry carrier frequency of 230 MHz is used with a bandwidth of
(a) ±320 kHz (b) ±490 kHz
(c) ±520 kHz (d) ±590 kHz

116. Ans: (c)

Sol: In Frequency Division Multiplexing (FDM), multiple signals are transmitted simultaneously, each within a unique frequency band. Telemetry systems often use specific carrier frequencies, such as 230 MHz, with a designated bandwidth to ensure efficient data transmission. The ±520 kHz bandwidth means the signal occupies a total range of 1.04 MHz around the carrier frequency

117. The potential transformer is used to operate voltmeters, potential coils of wattmeters and relays from
(a) high current lines (b) low current lines
(c) high voltage lines (d) low voltage lines

117: Ans: (c)

Sol: A potential transformer (PT) is used to step down high voltage to a lower, standardized level, making it safe for instruments like voltmeters, wattmeters, and protective relays to operate.

118. The output power wattmeter is designed to measure the output power

(a) inversely in an arbitrary load
(b) directly in an arbitrary load
(c) squared in an arbitrary load
(d) indirectly in an arbitrary load

118. Ans: (b)

Sol: An output power wattmeter is specifically designed to measure the power delivered to a load. It does this by directly sensing both voltage and current across the load and calculating power accordingly. The measurement is not inverse or squared but rather a direct representation of the power consumed by the load.

119. The nominal ratio K_n for a current transformer is

(a) $\dfrac{\text{Primary winding current}}{\text{Secondary winding current}}$

(b) $\dfrac{\text{Rated primary winding current}}{\text{Rated secondary winding current}}$

(c) $\dfrac{\text{Secondary winding current}}{\text{Primary winding current}}$

(d) $\dfrac{\text{Rated secondary winding current}}{\text{Rated primary winding current}}$

119. Ans: (b)

Sol: $K_n = \dfrac{\text{Rated primary current}}{\text{Rated secondary current}}$

120. Which one of the following generates an electrical signal directly in response to the physical parameter and does not require an external power source for its operation?

(a) Active transducer (b) Passive transducer
(c) Amplifier (d) Rectifier

120. Ans: (a)

Sol: An active transducer generates an electrical signal directly in response to a physical parameter, such as temperature, pressure, or light, without requiring an external power source. It operates based on principles like the piezoelectric effect, thermoelectric effect, or photovoltaic effect.

121. A very weak form of magnetism that is non-permanent persists only while an external field is being applied. It is induced by a change in the orbital motion of electrons due to an applied magnetic field. This form of magnetism is called

(a) ferromagnetism (b) ferrimagnetism
(c) paramagnetism (d) diamagnetism

121. Ans: (d)

Sol: Diamagnetic material donot have permanent dipoles and dipoles are induced by applying external field by change in the orbital motion of e^-

122. The magnetic moments of diamagnetic material are mainly due to

(a) orbital angular momentum of the electrons
(b) electron spin angular momentum of the electrons only
(c) nuclear spin angular momentum of the electrons only
(d) both electron spin angular momentum and nuclear spin angular momentum of the electrons

122. Ans: (a)

Sol: The magnetic moments of diamagnetic material are mainly due to orbital angular momentum of electrons.

123. The magnetic flux density on the surface of an iron

Hearty Congratulations
to our students GATE - 2025
84 TIMES AIR 1st IN GATE
AIR 1 PI Devendra Umbrajkar
AIR 1 EE Pradip Chauhan
AIR 1 IN Kailash Goyal
AIR 2 EE Kailash Goyal
AIR 2 ME Gollangi Sateesh
AIR 2 ES Jitesh Choudhary
AIR 3 ME Nimesh Chandra
AIR 3 ME Sanket Tupkar
AIR 3 PI Sadhan Anumala
AIR 3 XE Rohan Biswal
AIR 3 PI Aditya Kumar Prasad
AIR 4 CE Harshil Maheshwari
AIR 5 EC Mohammed Nafeez
AIR 5 IN Sachin Yadav
AIR 5 ME Uday G.
AIR 5 PI Kuldeep Singh naruka
AIR 6 CE Nimish Upadhyay
AIR 6 CE Shivanand Chaurasia
AIR 6 EE Shivam Kumar Gupta
AIR 6 EE Puneet Soni
AIR 6 EC P Jaswanth Bhavani
AIR 6 PI Kaushal Kumar Kaushik
AIR 7 EC Subhadip Dey
AIR 7 ME Abhinn Srivastava
AIR 7 IN Dev Jignesh Patel
AIR 7 DA Sairam Gudla
AIR 7 CS Hemanth Reddu P
AIR 7 PI Waleed Shaikh
AIR 7 XE Sanket Tupkar
AIR 8 ME Goutam Kumar
AIR 8 IN Pushpendra Payal
AIR 8 CS Rishi Sharma
AIR 9 EC Sai Charan Chilukuri
AIR 9 ME Rahul Paliwal
AIR 9 PI Anish Vanapalli
AIR 10 EE Neelava Mukherjee
AIR 10 ME Ashutosh kumar
AIR 10 ME Jetti Ganateja
AIR 10 ME Pitchika Kumar Vasu
AIR 10 CE Adnan Quasain
& mamy more....

face is 1.6 T, which is a typical saturation level value for ferromagnetic material. If the value of μ is $4\pi \times 10^{-7}$ H/m, the force density on the iron face will be nearly

(a) 0.25×10^6 N/m^2 (b) 1.0×10^6 N/m^2

(c) 2.0×10^6 N/m^2 (d) 4.0×10^6 N/m^2

123. Ans: (b)

Sol: Force density $= \dfrac{B^2}{2\mu_0}$

$$= \frac{(1.6)^2}{2\times4\pi\times10^{-7}} = 1.01\times10^6 \text{ N/m}^2$$

124. When a ferromagnetic substance is magnetized, there are small changes in its dimensions. The phenomenon is known as

(a) deformation (b) polarization

(c) magnetostriction (d) magnetization

124. Ans: (c)

Sol: Magnetostriction:

It is the ability of Ferromagnetic material that can change in physical dimensions by applying magnetic field

125. In Fe_3O_4, each cubic unit cell contains 8 Fe^{2+} and 16 Fe^{3+} ions, the unit cell edge length is 0.839 nm and Bohr magnetons/unit cell is 32 and the value of Bohr magneton is 9.27×10^{-24} A-m^2 /Bohr magneton. The saturation magnetization will be

(a) 1×10^5 A/m (b) 3×10^5 A/m

(c) 5×10^5 A/m (d) 7×10^5 A/m

125. Ans: (c)

Sol: No. of Fe^{2+} ions = n = 8

Lattice constant = a = 0.839 nm

Bohr magnetons/unit cell = 32

Value of Bohr magneton = $\mu_B = 9.27\times10^{-24}$

Saturation magnetization (M_S)

$$= \frac{\text{No. of Bohr magnetons}}{\text{Vol. of unit cell}}\times\mu_B$$

$$= \frac{32}{(0.839\times10^{-9})^3}\times9.27\times10^{-24}$$

$$= 5.022\times10^5$$

126. Which one of the following statements is not correct for Fermi level?

(a) When all the electrons have been accommodated in a metal atom, the number per level drops abruptly to zero, at an energy value E_f called Fermi level.

(b) The magnitude of Fermi level increases with the number of electrons per unit volume of the metal.

(c) The magnitude of Fermi level decreases with the number of electrons per unit volume of the metal.

(d) The extra electrons can only be accommodated in the higher energy levels.

126. Ans: (c)

Sol: The Fermi level does not decrease with increasing electron concentration, it increase so option (c) is not correct.

127. Electrons are emitted with zero velocity for a certain metal surface for c= 3×10^8 m/s and Å = 10^{-10} m, when it is exposed to radiations of λ = 6800 Å. The threshold frequency of the metal will be nearly

(a) 2.6×10^{14} Hz (b) 2.8×10^{14} Hz

(c) 3.6×10^{14} Hz (d) 4.4×10^{14} Hz

127. Ans: (d)

Sol: $C = 3 \times 10^8$ m/s

$\lambda = 6800\ \overset{0}{A}$

Threshold frequency of the metal = $f = \dfrac{C}{\lambda}$

$$f = \frac{3\times10^8}{6800\times10^{-10}} = 4.4\times10^{14}\ \text{Hz}$$

128. The materials which possess a permanent magnetic moment in the absence of an external field and manifest very large and permanent magnetizations are

(a) ferromagnetic (b) antiferromagnetic

(c) ferrimagnetic (d) superferrimagnetic

128. Ans: (a)

Sol: The ferromagnetic material posses a permanent magnetic dipole moment in the absence of an external field and generate large permanent magnetization

Eg: Fe, Co, Ni

129. The magnetic inductance becomes zero inside a superconductor when it is cooled below T_c in a weak external field. The magnetic flux is expelled from the interior of the superconductor. This effect is called

(a) Boltzmann effect

(b) Meissner-Ochsenfeld effect

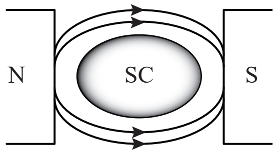
(c) critical temperature effect

(d) critical flux effect

129. Ans: (b)

Sol: **Meissner-Ochsenfeld effect**

It is the ability of super conductor below critical temperature that does not allow magnetic flux in the material. Superconductor expell magnetic flux



$B = 0$

$\mu = \dfrac{B}{H} = 0$

$\mu_R = \dfrac{\mu}{\mu_0} = 0$

$\mu_R = 1 + \chi = 0$

$\chi = -1$

130. In a network, the number of linearly independent mesh equations (M) is

(a) B+(N+1) (b) B–(N–1)

(c) B+(N–1) (d) B–(N+1)

where, B is number of branches in a network

N is number of nodes including the reference node

130. Ans: (b)

Sol: M = [B–N+1] = B – [N–1]

131. Which one of the following never dissipates energy but only stores it?

(a) Pure capacitor (b) Pure resistor

(c) Conductor (d) Ideal diode

131. Ans: (a)

Sol: Pure capacitor

132. An ideal voltage source is defined as energy source whose terminal voltage (V) is

(a) proportional to load with infinite internal resistance

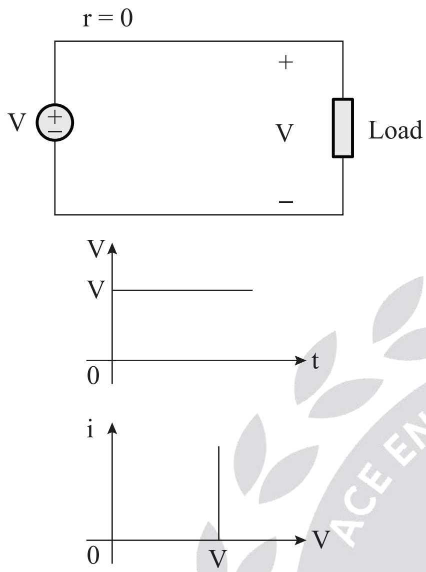
(b) dependent on the output current

(c) independent of the output current

(d) proportional to load with finite internal resistance

132. Ans: (c)

Sol:



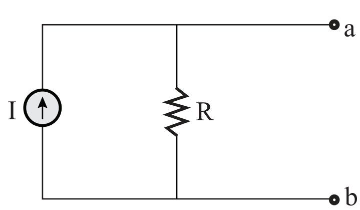
→Independent of output current.

133. Norton's theorem states that any two-terminal linear network with current sources, voltage sources and resistances can be replaced by an equivalent circuit consisting of a

(a) voltage source in parallel with a resistance
(b) voltage source in series with a resistance
(c) current source in series with a resistance
(d) current source in parallel with a resistance

133. Ans: (d)

Sol:

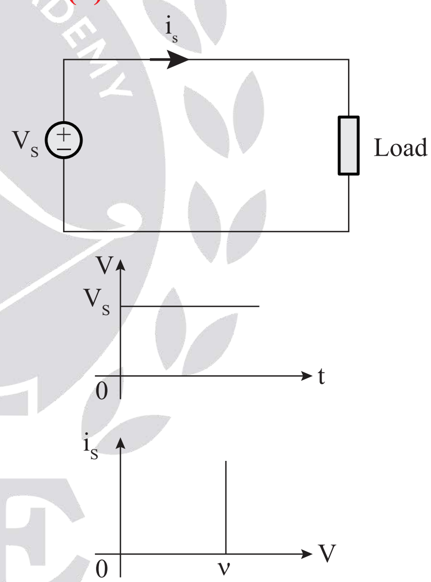


134. An ideal voltage source is a two-terminal element in which the

(a) current i_s is completely independent of the voltage
(b) voltage v_s is completely independent of the current i_s through its terminals
(c) current i_s is completely independent through its terminals
(d) voltage v_s is completely dependent on current i_s through its terminals

134. Ans: (b)

Sol:

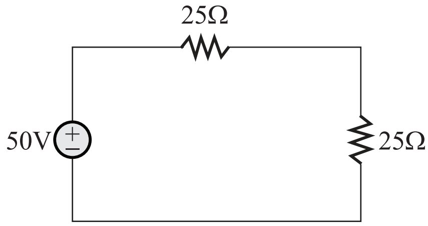


135. A circuit consists of a voltage source with 50 V and an internal resistance of 25Ω. If a load is connected to the voltage source, the maximum power drawn by the load resistance of 25Ω will be

(a) 15 W
(b) 20 W
(c) 25 W
(d) 30 W

135. Ans: (c)

Sol:



$$P_{max} = \frac{V_{TH}^2}{4R_{TH}} = \frac{50 \times 50}{4[25]} = 25W$$

136. What is the value of b such that the system of homogeneous equations

$$2x + y + 2z = 0$$
$$x + y + 3z = 0$$
$$4x + 3y + bz = 0$$

has non-trivial solution?

(a) 4 (b) 6
(c) 8 (d) 10

136. Ans: (c)

Sol: The condition for non-trivial solution of AX = 0 is $\rho(A) \neq$ no. of variables = n (or) |A| = 0

Condition |A| = 0

$$\begin{vmatrix} 2 & 1 & 2 \\ 1 & 1 & 3 \\ 4 & 3 & b \end{vmatrix} = 0$$

$2(b - 9) - 1(b - 12) + 2(3-4) = 0$

$2b - 18 - b + 12 - 2 = 0$

$\Rightarrow b = 8$

137. The orthogonal trajectories of the hyperbolas

$$x^2 - y^2 = c$$

are

(a) $x^2 + y^2 = c$ (b) $x + y = c$
(c) $xy = c$ (d) $x^2 + y^2 + 2x = c$

137. Ans: (c)

Sol: Given that $x^2 - y^2 = c$........ (1) which is a given equation of family of curves

Differentiating equation (1) w.r.t 'x' we get

$$2x - 2y\frac{dy}{dx} = 0$$

$\Rightarrow \frac{dy}{dx} = \frac{x}{y}$ .... (2) which is the differential equation of the given family of curves.

Replacing $\frac{dy}{dx}$ by $\frac{-dx}{dy}$ in equation (2), we get

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

$$\int \frac{1}{y} dy = \int \frac{-dx}{x} + \log c$$

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

$y = \frac{c}{x}$

$\therefore$ xy = c is the equation of required orthogonal trajectories

138. The value of the integral $\int_C x^2 y \; dS$, where C is the curve defined by

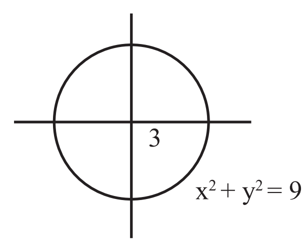
$x = 3\cos t,\; y = 3\sin t,\; 0 \le t \le \frac{\pi}{2}$

is

(a) 20 (b) 24
(c) 27 (d) 31

138. Ans: (c)

Sol: $\int_C x^2 y ds = \int_0^{\pi/2} f[r(t)] |r^1(t)| dt$




Hearty Congratulations
to our students ESE - 2024
35 TIMES AIR 1st IN ESE
AIR 1 CE Rohit Dhondge
AIR 1 E&T Himanshu T
AIR 1 EE Rajan Kumar
AIR 1 ME Munish Kumar
AIR 2 CE HARSHIT PANDEY
AIR 2 EE SATYAM CHANDRAKANT
AIR 2 ME RAJESH KASANIYA
AIR 3 CE LAXMIKANT
AIR 3 E&T UNNATI CHANSORIA
AIR 3 EE PRIYANSHU MUDGAL
AIR 3 ME GOLLANGI SATEESH
AIR 4 CE MADHAN KUMAR
AIR 4 E&T RAJIV RANJAN MISHRA
AIR 4 ME AJINKYA DAGDU
AIR 5 CE AMAN PRATAP SINGH
AIR 5 E&T PARAG SAROHA
AIR 5 EE MAYANK KUMAR S
AIR 5 ME BANKURU NAVEEN
AIR 6 CE SANCHIT GOEL
AIR 6 E&T CHANDRIKA GADGIL
AIR 6 EE RITVIK KOK
AIR 6 ME CHANDAN JOSHI
AIR 7 E&T DEBARGHYA CH
AIR 7 EE MANTHAN SHARMA
AIR 7 ME DINESH KUMAR S
AIR 8 CE ROHIT KUMAR
AIR 8 E&T VIDHU SHREE
AIR 8 EE MAYANK JAIMAN
AIR 8 ME SHAILENDRA SINGH
AIR 9 CE ANKIT MEENA
AIR 9 E&T T PIYUSH DAYANAND
AIR 9 EE ANMOL SINGH
AIR 9 ME KRISHNA KUMAR D
AIR 10 CE RAJESH BADUGU
AIR 10 E&T RAJVARDHAN SHARMA
AIR 10 ME AKSHAY VIDHATE
TOTAL 36 SELECTIONS IN TOP 10
CE: 09 | ME: 10 | EE: 08 | E&T: 09

$f(x, y) = x^2y$

$f(r(t)) = 27\cos^2 t \sin t$

$r(t) = (3\cos t, 3\sin t)$

$r^1(t) = -3\sin t, 3\cos t$

$|r^1(t)| = 3$

$$= \int_0^{\pi/2} (27\cos^2 t \sin t).3dt$$

$$= 81\left[\frac{-\cos x}{3}\right]^3$$

$$= -\frac{81}{3}.[\cos^3 x]_0^{\pi/2}$$

$$= -\frac{81}{3}[0-1] = 27$$

139. Let D be the region bounded by the closed cylinder $x^2 + y^2 = 16$, $z = 0$, $z = 4$, and $v = 3x^2 i + 6y^2 j + zk$, then by divergence theorem

$$\iiint_D (\nabla.v)dV$$

is

(a) 46π (b) 64π

(c) $84\,\pi$ (d) 96π

139. Ans: (b)

Sol: $\nabla.V = 6x + 12y + 1$

$x = r\cos\theta$, $y = r\sin\theta$, $z = z$

$$\iiint (\nabla.V)dV = \int_{r=0}^{2}\int_{\theta=0}^{2\pi}\int_{z=0}^{4}[6r\cos\theta + 12r\sin\theta + 1]rdrd\theta dz$$

$$= 6\left(\frac{r^3}{3}\right)_0^4 \times (\sin\theta)_0^{2\pi}(z)_0^4 + 12\left(\frac{r^3}{3}\right)_0^4(-\cos\theta)_0^{2\pi}(z)_0^4$$

$$+\left(\frac{r^2}{2}\right)_0^4 \times (\theta)_0^{2\pi} \times (z)_0^4$$

$= 0 + 256(-1 + 1)(4) + 8 \times 2\pi \times 4$

$= 0 + 0 + 64\pi$

140. In the Fourier series expansion of the function $f(x) = x\sin x,\ -\pi \le x \le \pi$ the value of the Fourier coefficient a_1 is

(a) $-\frac{3}{2}$ (b) $-\frac{1}{2}$

(c) $-\frac{2}{3}$ (d) $-\frac{2}{5}$

140. Ans: (b)

Sol: x sinx is even function

$$a_n = \frac{2}{c}\int_0^p f(x)\cos\left(\frac{n\pi x}{c}\right)dx$$

$$a_1 = \frac{2}{\pi}\int_0^\pi x\sin x\cos x dx = \frac{2}{\pi}\int_0^\pi \frac{1}{2}x\sin 2x dx$$

$$= \frac{1}{\pi}\int_0^\pi x\sin 2x dx$$

$$= \frac{1}{\pi}\left[-x\frac{\cos 2x}{2} + \frac{\sin 2x}{4}\right]_0^\pi$$

$$= -\frac{1}{2\pi}[\pi] = -\frac{1}{2}$$

141. The partial differential equation formed by the elimination of arbitrary function from

$$z = f(x^2 - y^2)$$

is

(a) $xp + yq = 0$ (b) $yp - xq = 0$

(c) $yp + zq = 0$ (d) $yp + xq = 0$

141. Ans: (d)

Sol: $z = f(x^2 - y^2)$

$$\frac{\partial z}{\partial x} = f'(x^2 - y^2)(2x); \frac{\partial z}{\partial y} = f'(x^2 - y^2)(-2y)$$

$$\frac{p}{q} = \frac{2x}{-2y} \Rightarrow -yp = qx$$

$$qx + py = 0$$

142. If one solution of the differential equation

$$(x^2 - y^2 - z^2)p + 2xyq = 2xz$$

is $\frac{y}{z} = a$, the other solution is

(a) $x^2 + y^2 + z^2 = b$
(b) $x^2 + y^2 + z^2 = zb$
(c) $x + y + z = b$
(d) $x + y + (1 - b)z = 0$

142. Ans: ((b)

Sol: Given that $(x^2 - y^2 - z^2).p + (2xy).q = (2xz)$ ..... (1)

$(\because P.p + Q.q = R)$

Consider $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$

$$\frac{dx}{x^2 - y^2 - z^2} = \frac{dy}{2xy} = \frac{dz}{2xz} \quad \text{....... (2)}$$

Let $\ell = x$, $m = y$ & $n = z$ be the required multipliers

Then $\frac{\ell dx + mdy + ndz}{\ell P + mQ + nR}$

$$= \frac{xdx + ydy + zdz}{x(x^2 - y^2 - z^2) + (2xy^2) + 2xz^2} \quad \text{....... (3)}$$

Combining (2) & (3), we get

$$\frac{dx}{x^2 - y^2 - z^2} = \frac{dy}{2xy} = \frac{dz}{2xz} = \frac{xdx + ydy + zdz}{x^3 + xy^2 + xz^2}$$

Consider $\frac{dz}{2xz} = \frac{(xdx + ydy + zdz)}{x(x^2 + y^2 + z^2)}$

$$\int \frac{1}{z}dz = \int \frac{2(xdx + ydy + zdz)}{x^2 + y^2 + z^2} + \log(c)$$

$\log(z) = \log(x^2 + y^2 + z^2) + \log(c)$

$z = c.(x^2 + y^2 + z^2)$

$\therefore x^2 + y^2 + z^2 = zb \qquad \left(\because b = \frac{1}{c}\right)$

143. The solution of the differential equation

$$p - x^2 = q + y^2$$

is

(a) $z = \left(\frac{x^3}{3} + cx\right) + \left(cy + \frac{y^3}{3}\right) + c_1$

(b) $z = \left(\frac{x^3}{3} - x\right) + \left(cy - \frac{y^3}{3}\right) + c_1$

(c) $z = \left(\frac{x^3}{3} - cx\right) + \left(cy + \frac{y^3}{3}\right) + c_1$

(d) $z = \left(\frac{x^3}{3} + cx\right) + \left(cy - \frac{y^3}{3}\right) + c_1$

143. Ans: (d)

Sol: $p - x^2 = a = q + y^2$

$\Rightarrow x^2 = p - a$; $y^2 = a - q$

$P = x^2 + a$; $q = a - y^2$

$z = \int pdx + \int qdy + c$

$$\Rightarrow z = \left(\frac{x^3}{3} + ax\right) + \left(ay - \frac{y^3}{3}\right) + c$$

144. The solution of the differential equation

$$p^2 + q^2 = x + y$$

is

(a) $z = \frac{2}{3}(a - x)^{3/2} + \frac{2}{3}(y + a)^{3/2} + b$

(b) $z = \frac{2}{3}(a - x)^{3/2} + \frac{2}{3}(y - a)^{3/2} + b$

(c) $z = \frac{2}{3}(a + x)^{3/2} + \frac{2}{3}(y + a)^{3/2} + b$

(d) $z = \frac{2}{3}(a + x)^{3/2} + \frac{2}{3}(y - a)^{3/2} + b$

144. Ans: (d)

Sol: $p^2 - x = a = y - q^2$

$\Rightarrow p = \sqrt{x + a}$: $q = \sqrt{y - a}$

$$z = \int (\sqrt{x + a})dx + \int (\sqrt{y - a})dy + C$$

$$z = \frac{(x + a)^{3/2}}{3/2} + \frac{(y - a)^{3/2}}{3/2} + C$$

145. The value of the integral $\int_C z^2 dz$, where C is the arc of the circle $|z| = 2$ from $\theta = 0$ to $\theta = \frac{\pi}{3}$, is

(a) $-\frac{12}{3}$ (b) $-\frac{14}{3}$

(c) $-\frac{16}{3}$ (d) $-\frac{18}{3}$

145. Ans: (c)

Sol: Let $I = \int_C z^2 dz$, where 'C' is the arc of the curve $|z| = 2$ from $\theta = \pm 0$ to $\theta = \frac{\pi}{3}$.

Then

$$I = \int_{\theta=0}^{\pi/3} (2e^{i\theta})^2 (2ie^{i\theta}) d\theta$$

$(\because |z| = 2 \Rightarrow z = 2e^{i\theta} \ \& \ dz = 2ie^{i\theta} d\theta)$

$$\Rightarrow I = 8i\left(\frac{e^{3i\theta}}{3i}\right)_0^{\pi/3}$$

$$\Rightarrow I = \frac{8}{3}\left[e^{3i\left(\frac{\pi}{3}\right)} - e^0\right]$$

$$\Rightarrow I = \frac{8}{3}[e^{i\pi} - 1] = \frac{8}{3}[\cos(\pi) + i\sin(\pi) - 1]$$

$$\therefore I = -\frac{8}{3}(2) = -\frac{16}{3}$$

146. The value of the integral $\oint_C \frac{dz}{z(z^2+4)}$, where C is $|z| = 1$, is

(a) 0 (b) $\frac{\pi i}{3}$

(c) $2\pi i$ (d) $\frac{\pi i}{2}$

146. Ans: (d)

Sol: Let $f(z) = \frac{1}{z(z^2+4)}$

Then the singular points are $z = 0, 2i, -2i$

Given region R is given by $|z| = 1$.

$\Rightarrow$ Only one singular point $z = 1$lies in the given region R

Consider $f(z) = \frac{\phi(z)}{(z - z_0)} = \frac{\left(\frac{1}{z^2+4}\right)}{[z-0]}$

Now, by Canchy's integral formula, we have

$$\oint_C f(z)dz = \oint_C \frac{\phi(z)}{[z-z_0]}dz = 2\pi i.\phi(z_0)$$

$$\Rightarrow \oint_C f(z)dz = \oint_C \frac{\left(\frac{1}{z^2+4}\right)}{[z-0]}dz = 2\pi i.\phi(0)$$

$$\Rightarrow \oint_C f(z)dz = 2\pi i\left[\frac{1}{z^2+4}\right]_{z=0}$$

$$\therefore \oint_C f(z)dz = \frac{\pi i}{2}$$

147. The mode and modal ordinate of normal distribution respectively are

(a) μ and $\frac{1}{\sigma\sqrt{2\pi}}$ (b) $\frac{\mu}{2}$ and $\frac{1}{\sigma\sqrt{2\pi}}$

(c) μ and $\frac{\sigma}{\sqrt{2\pi}}$ (d) $\frac{\mu}{2}$ and $\frac{\sigma}{\sqrt{2\pi}}$

147. Ans: (a)

Sol: Mean = μ

Model ordinate = Maximum value = $\frac{1}{\sigma\sqrt{2\pi}}$

148. The theoretical density of a metallic solid crystal structure is given by $\rho = \frac{nA}{V_C N_A}$ where n is number of atoms associate with each unit cell, A is atomic weight V_C is volume of the unit cell. N_A Will represent

(a) force in newton (b) number of particles
(c) Avogadro's number (d) number of turns

148. Ans: (c)

Sol: Theoretical density of metal = $\rho = \dfrac{nA}{V_C NA}$

n = no. of atoms/unit volume

A = Atomic weight g/mol

V_C = Volume of unit cell

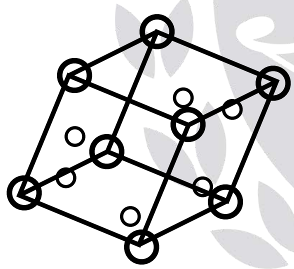
N_A = Avogadro's number

149. The value of packing fraction for face-centred cubic (FCC) structure will be nearly

(a) 0.55 (b) 0.65
(c) 0.75 (d) 0.85

149. Ans: (c)

Sol: **Atomic packing factor of FCC:**



n = 4

$a = 2\sqrt{2}r$

$V_{uc} = a^3 = 16\sqrt{2}R^3$

$$APF = \frac{n \times \frac{4}{3}\pi R^3}{V_{uc}}$$

$$= \frac{4 \times \frac{4}{3}\pi R^3}{16\sqrt{2} \times R^3} = 0.74$$

150. The total core loss of a specimen of silicon steel is found to be 1500 W at 50 Hz. Keeping the flux density constant, the loss becomes 3000 W, when the frequency is raised to 75 Hz.

The eddy current loss at 75 Hz will be

(a) 1.25 kW (b) 1.50 kW
(c) 1.75 kW (d) 2.25 kW

150. Ans: (d)

Sol: Given, W_{1i} = 1500 at 50Hz

W_{i2} = 3000 at 75 Hz

As B_m = constant

$\Rightarrow W_i = Af + Bf^2$

$\Rightarrow 1500 = A\times50 + B\times50^2$

$3000 = A\times75 + B\times75^2$

....

A = 10, B = 0.4

....

Eddy current loss, at 75Hz

$W_e = Bf^2 = 0.4\times75^2$

= 2250 W