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ELECTRONICS ENGINEERING

OBJECTIVE PRACTICE SETS VOLUME - IV

CONTENTS

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BASIC ELECTRICAL ENGINEERING

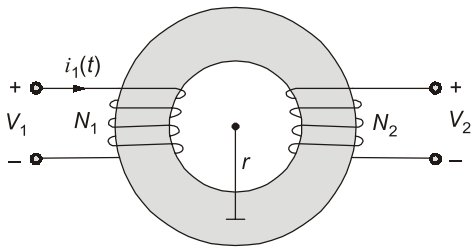
OBJECTIVE PRACTICE SETS

1 CHAPTER
Electromagnetism and DC Machines

Q.1 A coil of 1000 turns is wound on a core. A current of 1 A flowing through the coil creates a core flux of 1 mWb. The magnetic energy stored in the coil is
(a) 0.25 J (b) 0.5 J
(c) 1 J (d) 2 J

Q.2 An ideal transformer has N_1 = 100 turns and N_2 = 200 turns with a mutual flux of $\phi_m(t) = -0.05(t^2 - 2t)$. The induced emf of secondary is
(a) $5(t-1)$ V (b) $10(t-1)$ V
(c) $5(t^2-1)$ V (d) $20(t-1)$ V

Q.3 The magnetic circuit shown below has a uniform cross section of 10^{-3} m^2. If the circuit is energized by a current $i_1(t) = 3\sin 100\pi t$ A in the coil of N_1 = 200 turns, then the emf induced in the coil of N_2 = 100 turns will be
(Assume $\mu = 500\mu_0$ and r = 10 cm)



(a) $\frac{3\pi}{\sqrt{2}}\cos 100\pi t$ V (b) $-6\pi\cos 100\pi t$ V
(c) $4\pi\sin 100\pi t$ V (d) $-3\pi\cos 100\pi t$ V

Q.4 In a dc motor the windage loss is proportional to
(a) supply voltage
(b) square of the supply voltage
(c) square of the flux density
(d) square of the armature speed

Q.5 Wave winding is employed in a d.c. machine of
(a) high current and low voltage rating
(b) low current and high voltage rating
(c) high current and high voltage rating
(d) low current and low voltage rating

Q.6 The emf induced in each conductor of the armature in a dc machine is
(a) alternating in nature
(b) direct in nature
(c) pulsating in nature
(d) has a random waveshape

Q.7 For a P-pole machine, the relation between electrical and mechanical degrees is
(a) $\theta_{elec} = \frac{2}{P}\theta_{mech}$ (b) $\theta_{elec} = \frac{4}{P}\theta_{mech}$
(c) $\theta_{elec} = \theta_{mech}$ (d) $\theta_{elec} = \frac{P}{2}\theta_{mech}$

Q.8 The commutator of the dc motor serves the purpose of
(a) changing ac to dc
(b) changing dc to ac
(c) reducing friction
(d) avoiding sparking at the crushes

Q.9 In dc machines, the field-flux axis and armature-mmf axis are respectively along
(a) direct axis and indirect axis
(b) direct axis and inter-polar axis
(c) quadrature axis and direct axis
(d) quadrature axis and inter-polar axis

Q.10 Normally a large number of commutator segments are used in a dc generator to
(a) increase the magnitude of the output voltage
(b) increase the output current
(c) increase the kW power output
(d) make the dc output more smooth

Q.11 The armature resistance of a 6-pole lap wound d.c. machine is 0.05 Ω. If the armature is rewound as a wave-winding, what is the armature resistance?
(a) 0.45 Ω (b) 0.30 Ω
(c) 0.15 Ω (d) 0.10 Ω

Q.12 Which of the following windings are necessary in case of all dc machines?
(a) lap winding (b) wave winding
(c) closed coil winding (d) open coil winding

Q.13 In a dc machine, the constant losses are
(a) armature copper loss
(b) shunt field copper loss
(c) iron and mechanical loss
(d) (b) and (c) both

Q.14 The function(s) of pole shoes in a dc machine is/are to
(a) support the field coils.
(b) reduce the reluctance of the magnetic path.
(c) spread out the flux to achieve uniform flux distribution in the air gap.
(d) all of the above.

Q.15 In a dc machine mechanical losses occur due to
(a) air resistance of rotation to armature and fan
(b) brush friction
(c) bearing friction
(d) all the above

Q.16 In a dc motor if the brushes are shifted opposite to its direction of rotation, then
(a) commutation is worsened and speed decreases.
(b) commutation is improved and speed decreases.
(c) commutation is worsened and speed increase.
(d) commutation is improved and speed increase.

Q.17 The field coils of a dc generator are usually made of
(a) mica (b) copper
(c) cast iron (d) carbon

Q.18 Consider the following statements and choose the correct option:
1. Slot wedges in a DC machine made of silicon steel.
2. In a DC machine armature is stationary, yoke rotates.
3. The air gap between the yoke and armature in a DC motor is kept small in order to achieve a stronger magnetic field.
(a) Only statement 2 is correct
(b) Only statements 1 and 2 are incorrect
(c) Only statements 2 and 3 are incorrect
(d) All statements are correct

Q.19 Consider the following statements in respect of compensating windings in dc motors:
1. Compensating windings are connected in series with the armature.
2. Compensating windings aid commutation.
3. Compensating windings produce mmf in the same direction as that of armature mmf.
Which of these statements is/are correct?
(a) 2 and 3 (b) Only 1
(c) 1 and 3 (d) 1 and 2

Q.20 An eight pole d.c. generator has a simple wave wound armature containing 32 coils of 6 turns each. Its flux per pole is 0.06 Wb. The machine is running at 250 rpm. The induced armature voltage is
(a) 96 V (b) 192 V
(c) 384 V (d) 768 V

Q.21 Consider the following parts of a dc machine:
1. Yoke 2. Armature core
3. Brushes 4. Pole core
Which of the above parts are subjected to iron loss?
(a) 1 and 2 only (b) 2 only
(c) 1 only (d) 1, 2, 3 and 4

Q.22 A triangular mmf wave is produced in the air-gap of an electric machine. Such a wave is produced by
(a) stator of an induction machine
(b) rotor of a synchronous machine
(c) stator of a dc machine
(d) rotor of a dc machine

Q.23 **Assertion (A):** For a symmetrical magnetic field distribution under each pole and for equal number of armature conductors per parallel path, the emf available between adjacent brushes of a lap-wound dc machine is equal for each of the parallel paths.
Reason (R): The instantaneous emf induced in each conductor of each parallel path is equal for all the conductors.
(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not a correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Q.24 At the moment of starting a dc motor, its back emf is
(a) zero (b) maximum
(c) minimum (d) optimum

Q.25 A dc shunt motor with negligible armature resistance is required to drive a constant power load. Under normal rated-load operating conditions

Codes:

	A	B	C	D
(a)	4	1	2	3
(b)	3	2	1	4
(c)	4	2	1	3
(d)	3	1	2	4

Q.66 Match **List-I** (Motors) with **List-II** (Applications) and select the correct answer:

List-I

A. dc series motor
B. Squirrel-cage induction motor
C. dc shunt motor

List-II

1. Shearing and pressing
2. Haulage and hoisting
3. Rolling mill

Codes:

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	3	1	2
(d)	3	2	1

Q.67 Match **List-I** (Types of electrical loads) with **List-II** (Torque-speed characteristics) and select the correct answer:

List-I

A. Hoist
B. Fans
C. Machine Tools (Lathe, Milling machine etc)
D. Loads with fluid friction

List-II

1. Torque $\propto$ (speed)^2
2. Torque $\propto$ (speed)
3. Constant Torque
4. Torque $\propto$ 1/(speed)

Codes:

	A	B	C	D
(a)	1	3	2	4
(b)	1	3	4	2
(c)	4	1	3	2
(d)	3	1	2	4

Q.68 **Statement (I):** DC series motors are used in electric locomotives, cranes, etc.

Statement (II): DC series motors provide high starting torque.

(a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are true but Statement (II) is not a 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.

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Answers Electromagnetism and DC Machines

1. (b)	2. (d)	3. (b)	4. (d)	5. (b)	6. (a)	7. (d)	8. (b)	9. (b)
10. (d)	11. (a)	12. (c)	13. (d)	14. (d)	15. (d)	16. (d)	17. (b)	18. (a)
19. (d)	20. (c)	21. (b)	22. (d)	23. (c)	24. (a)	25. (a)	26. (d)	27. (c)
28. (b)	29. (c)	30. (c)	31. (c)	32. (b)	33. (b)	34. (a)	35. (a)	36. (b)
37. (d)	38. (a)	39. (c)	40. (c)	41. (a)	42. (c)	43. (c)	44. (b)	45. (a)
46. (c)	47. (d)	48. (b)	49. (c)	50. (a)	51. (a)	52. (c)	53. (a)	54. (d)
55. (a)	56. (a)	57. (b)	58. (a)	59. (a)	60. (d)	61. (c)	62. (a)	63. (d)
64. (c)	65. (d)	66. (b)	67. (c)	68. (a)				

Explanations **Electromagnetism and DC Machines**

1. (b)

$$N\phi = Li$$

$$E = \frac{1}{2}Li^2 = \frac{1}{2}\left(\frac{N\phi}{i}\right)i^2$$

$$= \frac{1}{2}\times 1000\times 10^{-3}\times 1 = \frac{1}{2}J$$

2. (d)

Induced emf in secondary coil $= -N_2\frac{d\phi_m}{dt}$

$$= -200\frac{d}{dt}[-0.05(t^2-2t)]$$

$$= 10\frac{d}{dt}(t^2-2t) = 10(2t-2)$$

$$= 20(t-1)$$

3. (b)

The magnetic flux in the circuit,

$$\phi_1 = \frac{N_1 I_1}{S_1} = \frac{N_1 I_1}{l/\mu A} = \frac{N_1 I_1 \mu A}{2\pi r}$$

where, S_1 = Magnetic reluctance

According to Faraday's law, the emf induced in the second coil is

$$e_2 = -N_2\frac{d\phi}{dt}$$

$$e_2 = \frac{-100\times 200\times 500\times 4\pi\times 10^{-7}\times 10^{-3}}{2\pi\times 10\times 10^{-2}}\frac{dI_1(t)}{dt}$$

$$= -\frac{1}{50}\frac{d}{dt}(3\sin 100\pi t) = -6\pi\cos 100\pi t\ \text{V}$$

4. (d)

Windage loss $\propto$ (armature speed)^2

5. (b)

Wave winding: Low current and high voltage rating.

Lap winding: High current and low voltage rating.

6. (a)

EMF induced is alternating in nature.

7. (d)

One mechanical rotation covers $P/2$ electrical cycles

$$\theta_{elec} = \frac{P}{2}\theta_{mech}$$

8. (b)

DC motor is supplied with dc power at its terminal which is converted in ac with help of commutator for motor operation.

9. (b)

Field flux axis and armature axis are respectively along direct axis and inter-polar axis.

10. (d)

To make DC output more smooth.

11. (a)

In lap winding no. of parallel paths $A = P = 6$

$\therefore$ Resistance of single path R is given by

$$\frac{R}{6} = 0.05 \Rightarrow R = 0.30\ \Omega$$

In wave winding $A = 2$, so single path would have resistance of $3R$.

$$\therefore \text{armature resistance} = \frac{3R}{2} = \frac{3}{2}\times 0.3 = 0.45\ \Omega$$

12. (c)

In case of all dc machines we must use closed winding. Lap and wave windings are used based on requirement of high current, low voltage and high voltage, low current but winding of all dc machines is closed winding. It is never short pitched. Open coil winding is usually employed in ac machines.

13. (d)

Constant losses = Iron losses
Mechanical losses
Shunt field Cu loss

14. (d)

All the statements are correct.

15. (d)

Mechanical are due to: Brush friction, Bearing friction and air resistance of rotation.

16. (d)

The distortion of flux is in a direction opposite to the direction of rotation of motor. So brush is shifted in a direction opposite to motor rotation.

ADVANCED COMMUNICATION

OBJECTIVE PRACTICE SETS

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1 CHAPTER
Microwave Communication

Q.1 The frequency range of very high frequency (VHF) is
(a) 300 MHz – 3000 MHz
(b) 30 MHz – 300 MHz
(c) 3 MHz – 30 MHz
(d) 30 THz – 3000 Hz

Q.2 One of the reasons why vacuum tubes eventually fail at microwave frequencies is that their
(a) transmit time becomes too short
(b) noise figure increases
(c) shunt capacitive reactance becomes too large
(d) series inductive reactance becomes too small

Q.3 In microwave communication links, when fading due to rain attenuation occurs, the techniques adopted for solving the problem would include
(a) antenna replacement and feed correction
(b) amplitude trimming and phase correction
(c) polarization shifting and code diversity
(d) path diversity and frequency diversity

Q.4 Ionospheric propagation is not possible for microwave because
(a) microwaves will be fully absorbed by the ionospheric layers
(b) there will be an abrupt scattering in all direction
(c) microwaves will penetrate through the ionospheric layers
(d) there will be dispersion of microwave energy

Q.5 The MUF for an angle of incidence of 60° and a critical frequency of 60 MHz will be
(a) 45.0 MHz (b) 111.7 MHz
(c) 120 MHz (d) 150 MHz

Q.6 Calculate the critical frequency of *E*-layer if its average density is 10^{10} per cubic meter?
(a) 6×10^5 Hz (b) 7×10^5 Hz
(c) 8×10^5 Hz (d) 9×10^5 Hz

Q.7 A microwave communication link employs two antennas for transmission and reception elevated at 200 m and 80 m, respectively. Considering obliqueness of the Earth, the maximum possible link distance is
(a) 46 km (b) 64 km
(c) 96 km (d) 102 km

Q.8 Transmission of signals in a terrestrial microwave system is achieved through
(a) reflection from the ionosphere
(b) line-of-sight mode
(c) reflection from the ground
(d) diffraction from the stratosphere

Q.9 In the terrestrial paths of a microwave communication system, which technique is usually adopted to overcome signal loss due to earth's curvature?
(a) Link repeaters are arranged with 50 km apart
(b) Link repeaters are arranged with 500 km apart
(c) Signal amplifiers are arranged every 5 km apart
(d) Phase correctors are located every 2 km apart

Q.10 In microwave communication, sometimes microwave signals reach large distances by following the earth's curvature. This phenomenon is called
(a) tropospheric scatter
(b) Faraday effect
(c) ionospheric reflection
(d) ducting

Q.11 During power measurement the out power measured was –90 dBm. What is the measured power in W?
(a) 1 mW (b) 1 pW
(c) 10 W (d) 1 W

Q.12 Two LOS antennas having power gains of G_1 and G_2 are separated by a distance 'L'. λ is the operating wavelength. If P_t is the transmitted power and P_r is the power received, then the ratio P_r/P_t will be proportional to

(a) $G_1G_2\left(\frac{L}{\lambda}\right)^2$ (b) $\frac{G_1}{G_2}\left(\frac{L}{\lambda}\right)^2$

(c) $\frac{G_2}{G_1}\left(\frac{L}{\lambda}\right)^2$ (d) $G_1G_2\left(\frac{\lambda}{L}\right)^2$

Q.13 Free-space propagation path loss is

(a) inversely proportional to frequency of transmission.
(b) directly proportional to frequency of transmission.
(c) directly proportional to distance of transmission.
(d) directly proportional to square of the frequency of transmission.

Q.14 Duct propagation of microwave occurs due to which one of the following?

(a) Variation of refractive index with wavelength
(b) Variation of refractive index with length
(c) Variation of refractive index with height
(d) None of the above

Q.15 Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:

List-I	List-II
A. Ground wave	1. 3 - 30 MHz
B. Space wave	2. < 3 MHz
C. Sky wave	3. > 300 MHz
D. Troposcatter wave	4. 30 - 300 MHz

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	3	4	2	1
(c)	4	3	2	1
(d)	2	4	1	3

Q.16 Maximum frequency reflected from an ionospheric layer is 9 MHz. The maximum ion density of that layer is

(a) $10^8\ m^{-3}$ (b) $10^6\ m^{-3}$
(c) $10^{12}\ m^{-3}$ (d) $10^9\ m^{-3}$

Q.17 Consider the following statements about the maximum usable frequency (MUF) for radio communication between two specified points using an ionospheric layer

1. MUF is equal to critical frequency
2. MUF is more than the critical frequency
3. MUF depends upon the height of the ionospheric layer
4. MUF depends upon the distance between the two points

Which of these statements are correct?

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

Q.18 Consider the following statements regarding a microwave link:

1. Fade margin (sometimes called link margin) is essentially included in system gain equation that considers the non-ideal and less predictable characteristics.
2. The system gain depends on the gain of both transmitter and receiver antennas.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

Q.19 What should be the frequencies used for communication inside the coal mines, from the viewpoint of minimizing the propagation path loss?

(a) In the range from 30 MHz to 400 MHz
(b) In the range from 1 GHz to 4 GHz
(c) In the range from 500 MHz to 1 GHz
(d) In the range from 1 GHz to 2 GHz

Q.20 A microwave transmitting antenna is placed at a height of 100 m and the receiving antenna is placed at ground level. It is intended to increase the line-of-sight distance between transmitter and receiver by 20% from the existing value. Then to achieve this, the transmitting antenna should be placed at a height of

(a) 112 m (b) 120 m
(c) 144 m (d) 164 m

Q.21 The free-space path loss at a distance of 16 km from a microwave antenna operating at 2 GHz is approximately equal to

(a) 167.5 dB (b) 122.5 dB
(c) 90 dB (d) 77.5 dB

Q.22 Consider the following statements about microwave communication:

1. Minimum delay time is introduced in communication.
2. Transit time is more critical at microwave frequencies.

3. It is more easy to analyse and design circuits at microwave frequencies.

Which of the above statements is/are **incorrect**?

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

Q.23 **Statement (I):** Space wave is used for propagation of FM broadcast system.

Statement (II): Several independent interference free transmitters can be operated on the same frequency because of line-of-sight propagation.

(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.

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Answers Microwave Communication

1. (b)	**2.** (a)	**3.** (d)	**4.** (c)	**5.** (c)	**6.** (d)	**7.** (c)	**8.** (b)	**9.** (a)
10. (d)	**11.** (b)	**12.** (d)	**13.** (d)	**14.** (c)	**15.** (d)	**16.** (c)	**17.** (d)	**18.** (c)
19. (a)	**20.** (c)	**21.** (b)	**22.** (c)	**23.** (a)				

Explanations Microwave Communication

1. (b)

Frequency range:

VLF = 3 – 30 kHz
LF = 30 – 300 kHz
MF = 0.3 – 3 MHz
HF = 3 – 30 MHz
VHF = 30 – 300 MHz
UHF = 300 – 3 GHz
SHF = 3 – 30 GHz
EHF = 30 – 300 GHz

2. (a)

Transit time is the time taken by electrons to travel from cathode to anode. At microwave frequencies, the transit time becomes comparable to the time period and hence, the vacuum tubes fail at microwave frequencies.

3. (d)

Diversity techniques are used to improve the performance of a fading radio channel, wherein multiple copies of the same information is transmitted to the receiver on statistically independent paths/channels. To overcome fading due to rain attenuation, path diversity and frequency diversity can be used wherein multiple copies of the signal are transmitted over different paths and frequencies respectively.

4. (c)

Microwave frequencies penetrate through the ionosphere and are not reflected back. In general, frequencies above 30 MHz will penetrate through ionosphere.

5. (c)

$$f_{MUF} = f_c \sec\theta_i = \frac{f_c}{\cos\theta_i}$$

$$f_{MUF} = \frac{60}{0.5} = 120 \text{ MHz}$$

6. (d)

Critical frequency,

$$f_c = \sqrt{81 \times N_{max}}$$

$$= \sqrt{81 \times 10^{10}} = 9 \times 10^5 \text{Hz}$$

7. (c)

$h_t = 200$ m
$h_r = 80$ m

$$d = 4.12\left[\sqrt{h_t} + \sqrt{h_r}\right] \text{km}$$

$$= 4.12\left[\sqrt{200} + \sqrt{80}\right] \text{km}$$

$$= 95.11 \text{ km} \simeq 96 \text{ km}$$

8. (b)

Terrestrial microwave system use line-of-sight transmission and signals travel in straight line.

9. (a)

Microwave signals propagate along the line of sight. Therefore, the Earth's curvature limits the range over which a microwave communication link can be established. A transmitting antenna sitting on a 25 ft high tower can typically communicate only up to a distance of about 50 km. Repeaters can be placed at regular intervals to extend the range, which receives and retransmits the signal.

10. (d)

At VHF, UHF and microwaves, the waves are neither reflected by ionosphere nor propagated along the earth's surface but the transmission occurs beyond the line of sight distance due to refraction of such high frequency waves in the troposphere. Due to turbulence in air, different layers of air have different temperature and vapour contents which leads to formation of the air forming a duct or a sort of leaky waveguide which guides the electromagnetic wave between the walls.

11. (b)

$$-90 \text{ dBm} = 10\log\frac{P(\text{Watts})}{1\times10^{-3}}$$

$$\frac{P(\text{watts})}{10^{-3}} = 10^{-9}$$

$$P = 10^{-12} \text{ watts} = 1 \text{ pW}$$

12. (d)

As per the FRIIS equation,

$$P_r = \frac{P_t \cdot G_t \cdot G_r}{\left(\frac{4\pi d}{\lambda}\right)^2}$$

G_t = Gain of transmitting antenna
G_r = Gain of receiving antenna
P_t = Transmitted power
d = Distance between antennas

$$P_r = P_t G_1 G_2 \left(\frac{\lambda}{4\pi L}\right)^2$$

$$\therefore \quad \frac{P_r}{P_t} \propto G_1 G_2 \left(\frac{\lambda}{L}\right)^2$$

13. (d)

$$(\text{FSL}) = \left(\frac{4\pi d}{\lambda}\right)^2 = \left(\frac{4\pi df}{c}\right)^2$$

14. (c)

Duct propagation occurs due to variation of refractive index with height and the wave propagates because of refraction.

15. (d)

Ground-wave : Attenuation of earth increases as the frequency increases and hence, the mode of propagation is suitable for low and medium frequency, i.e., upto 3 MHz only.

Sky-wave : Frequencies above 30 MHz penetrate through ionosphere and hence, sky-wave propagation not possible beyond 30 MHz.

Space-wave : Space-wave is mainly used for frequencies above 30 MHz, i.e., VHF. At such frequency, sky wave and ground wave propagation fails.

Tropospheric scatter propagation: It is used for VHF and microwaves, i.e., above 300 MHz.

16. (c)

$$f_c = 9\sqrt{N_{\max}}$$

$$9\times10^6 = 9\times\sqrt{N_{\max}}$$

$$N_{\max} = (10^6)^2 \text{ m}^{-3} = 10^{12} \text{ m}^{-3}$$

17. (d)

$$\text{MUF} = f_c \sec\phi_i$$

where, f_c = critical frequency
ϕ = incidence angle

So MUF > f_c

Also angle of incidence is governed by the distance between the two points.

18. (c)

Fade margin is taken as the safety margin to compensate against path fading that weakens the radio signals. Fade margin is the insurance against unexpected system outrages.

Also,

$P_r(dB) = P_t(dB) + G_t(dB) + G_r(dB) - P_L(dB)$

$P_r(dB) - P_t(dB) = G_t(dB) + G_r(dB) - P_L(dB)$

Hence, the system gain depends on the gain of both transmitter and receiver antennas.

19. (a)

$$\text{Path loss} = \left(\frac{4\pi d}{\lambda}\right)^2 = \left(\frac{4\pi d}{c}\right)^2 \cdot f^2$$

ADVANCED ELECTRONICS

OBJECTIVE PRACTICE SETS

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1 CHAPTER
Introduction to VLSI Technology

Q.1 What is meant by the term VLSI?
(a) A device containing between 10^3 and 10^5 transistors.
(b) A device containing 10^5 and 10^7 transistors.
(c) A device containing between 10^7 and 10^9 transistors.
(d) A device containing between 10^9 and 10^{11} transistors.

Q.2 In integrated circuits, the design of electronic circuits is based on the approach of use of
(a) maximum number of resistors in the circuit
(b) large sized capacitor
(c) minimum chip area irrespective of the type of components in the design
(d) use of only bipolar transistors

Q.3 Which 'law' describes the exponential growth of integrated circuit complexity?
(a) Nyquist theorem (b) Moore law
(c) Faraday law (d) Lenz law

Q.4 What is meant by the term monolithic IC?
(a) Only one circuit element on IC
(b) Small IC
(c) Complete circuit on a single piece of silicon
(d) None of the above

Q.5 Diffusion, an important process in VLSI fabrication is governed by which law?
(a) Gauss law (b) Fick's law
(c) Charle's law (d) Boyle's law

Q.6 Which among the following functions are performed by MSI category of IC technology?
(a) Gates, Op-amps
(b) Microprocessor / AD
(c) Filters
(d) Memory / DSP

Q.7 ICs are generally made of _____.
(a) silicon (b) germanium
(c) copper (d) none of the above

Q.8 Consider the following statements:
Resistance in integrated circuit are:
1. Avoided since they contribute to power dissipation.
2. Included to increase current drain.
3. Values of 50 kΩ and above.
4. Avoided due to difficulty in fabricating required values.

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

Q.9 _____ cannot be fabricated on an IC.
(a) Transistors
(b) Diodes
(c) Resistors
(d) Large inductors and transformers

Q.10 The active components in an IC are _____.
(a) resistors
(b) capacitors
(c) transistors and diodes
(d) none of the above

Q.11 Which of the following capacitors are used widely for capacitance applications in monolithic ICs.
1. MOS capacitor
2. Collector Substrate capacitor
3. Collector-Base capacitor
4. Base -Emitter capacitor

Select the correct answer using the code given below:
(a) 1 and 2 only (b) 2 and 3 only
(c) 3 and 4 only (d) 1 and 4 only

Q.12 FPGA-based design is more suitable for
(a) large volume production
(b) prototype development
(c) high speed applications
(d) low power applications

Q.13 Which of the following are the advantages offered by retrograde well technology over conventional well technology of CMOS fabrication?
1. Increased device density.
2. Minimized latch-up problem.
3. Reduced chance of punch-through from drain to source.

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

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Answers Introduction to VLSI Technology

1. (b)	2. (c)	3. (b)	4. (c)	5. (b)	6. (c)	7. (a)	8. (d)	9. (d)
10. (c)	11. (a)	12. (b)	13. (d)					

Explanations Introduction to VLSI Technology

4. (c)

A monolithic IC is a set of electronic circuit on a single chip.

5. (b)

Fick's law states: $J = -D\frac{\partial N}{\partial x}$

7. (a)

Silicon is cheaply available.
SiO_2 a good insulator and can be easily formed.

8. (d)

Monolithic IC resistances are used in IC's

13. (d)

In retrograde well technology, high-energy implantation is used. So, it can form the well under low-temperature and short-time conditions. Hence, it can reduce the lateral diffusion and increase the device density. The doping profile of the well, in this case, can have a peak at a certain depth in the silicon substrate. Because of high doping near the bottom, the well resistivity is lower than that of the conventional well, and the latch-up problem can be minimized.
Higher well doping at the bottom can also reduce the chance of punch through from the drain to the source.

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COMPUTER ORGANIZATION AND ARCHITECTURE

OBJECTIVE PRACTICE SETS

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1
CHAPTER

Computer Organization and Architecture

Memory Organization and IO Organization

Q.1 When an interrupt occurs, an operating system
(a) ignores the interrupt
(b) always changes state of interrupted process after processing the interrupt
(c) always resumes execution of interrupted process after processing the interrupt
(d) may change state of interrupted process to 'blocked' and schedule another process

Q.2 A system uses FIFO policy for page replacement. It has 4 page frames with no pages loaded to begin with. The system first accesses 100 distinct pages in some order and then accesses the same 100 pages but now in the reverse order. How many page faults will occur?
(a) 196 (b) 192
(c) 197 (d) 195

Q.3 If the associativity of a processor cache is doubled while keeping the capacity and block size unchanged, which one of the following is guaranteed to be NOT affected?
(a) Width of tag comparator
(b) Width of set index decoder
(c) Width of way selection multiplexor
(d) Width of processor to main memory data bus

Q.4 According to temporal locality, processes are likely to reference pages that
(a) have been referenced recently.
(b) are located at address near recently referenced pages in memory.
(c) have been preloaded in memory.
(d) None of these

Q.5 A system which has a lot of crashes, data should be written to the disk, using
(a) Write – through
(b) Write – back
(c) Any one from (a) and (b)
(c) Some other techniques are required and none of the above can do this.

Q.6 The principle of locality justifies the use of
(a) Interrupts (b) Threads
(c) DMA (d) Cache Memory

Q.7 Consider a system with 2 level cache. Access times of level 1 cache, level 2 cache and main memory are 1 ns, 10 ns and 500 ns respectively. The hit rates of level 1 and level 2 caches are 0.8 and 0.9 respectively. What is the average access time of the system ignoring the search time within the cache?
(a) 13.0 (b) 12.8
(c) 12.6 (d) 12.4

Q.8 Consider a memory system with the following parameters :

T_c = Cache Access Time
= 100 ns
T_m = Main Memory Access Time
= 1200 ns

If we would like to have effective (average) memory access time to be or more than 20% higher than cache access time, the hit ratio for the cache must at least be :
(a) 80% (b) 90%
(c) 98% (d) 99%

Q.9 A disc drive has an average seek time of 10 ms, 32 sectors on each track and 512 bytes per sector. If the average time to read 8 kbytes of continuously stored data is 20 ms, what is the rotational speed of the disc drive?
(a) 3600 rpm (b) 6000 rpm
(c) 3000 rpm (d) 2400 rpm

Q.10 In a microprocessor, the service routine for a certain interrupt starts from a fixed location of memory which cannot be externally set, but the interrupt can be delayed or rejected. Such an interrupt is
(a) Non-maskable and non-vectored
(b) Maskable and non-vectored
(c) Non-maskable and vectored
(d) Maskable and vectored

Q.11 The access time of a cache memory is 100 ns and that of main memory is 1 μs. 80% of the memory requests are for read and others are for write.

Hit ratio for read only accesses is 0.9. A write through procedure is used. The average access time of the system for both read and write requests is

(a) 200 ns (b) 360 ns
(c) 720 ns (d) 1100 ns

Q.12 A computer system has a 4 K word cache organized in block-set associative manner with 4 blocks per set, 64 words per block. The numbers of bits in the SET and WORD fields of the main memory address formula are respectively

(a) 15 and 4 (b) 6 and 4
(c) 7 and 2 (d) 4 and 6

Q.13 Which of the following requires a device driver?

(a) Register (b) Cache
(c) Main memory (d) Disk

Q.14 A disk pack contains 6 disks. Data can be read/written from both the surfaces of the disk. There are 200 tracks on each disk surface, each track is divided into 50 sectors and each sector contains 512 B. What is the total storage capacity of the disk pack (in bytes)?

(a) $512 \times 50 \times 200 \times 12$
(b) $512 \times 50 \times 200 \times 20$
(c) $512 \times 50 \times 200 \times 6$
(d) $\frac{512 \times 50 \times 200 \times 6}{2}$

Q.15 Which of the following semiconductor memory is used for cache memory?

(a) SRAM (b) DRAM
(c) ROM (d) PROM

Q.16 In a cache with 64-byte cache lines, how many bits are used to determine which byte within a cache line an address points to?

(a) 16 (b) 8
(c) 6 (d) 3

Q.17 Consider a system that uses interrupt driven I/O for a particular device which has an average data transfer rate of 8 kbps. The processing of the interrupt which includes the time to jump to ISR, its execution and returning to the main program is 100 μs. What fraction of processor time consume by the device, if the device interrupts for every 1 byte (in %)?

(a) 80 (b) 40
(c) 20 (d) 100

Q.18 The write through procedure is used

(a) To write on the memory directly.
(b) To write and read from memory simultaneously.
(c) To write directly on the memory and cache whenever a hit occurs on a cache.
(d) None of the above.

Q.19 The fastest data access is provided using

(a) Caches (b) DRAM's
(c) SRAM's (d) Registers

Q.20 Consider the following statements :

1. The processor interrupts the program currently being executed.
2. The action requested by the interrupt is performed by the ISR.
3. Interrupts are enabled and execution of the interrupted program is resumed.
4. The device raises an interrupt request.
5. The device is informed that its request has been recognized and in response, it deactivates the interrupt request signal.

Arrange the above statements meaningfully, then what should be the sequence?

(a) 4, 5, 1, 2, 3 (b) 4, 1, 5, 2, 3
(c) 2, 4, 5, 1, 3 (d) 4, 5, 1, 3, 2

Q.21 The total size of address space in a virtual memory system is limited by

(a) the length of MAR
(b) the available secondary storage
(c) the available main memory
(d) All of the above

Q.22 The minimum time delay between the initiations of two independent memory operations is called

(a) Access Time (b) Cycle Time
(c) Transfer Time (d) Latency Time

Q.23 Which of the following statement(s) is/are true?

Statement 1 : The main advantage of direct mapping is that the cache hit ratio increases drastically if two or more frequently used blocks map onto same region.

Statement 2 : For two-level memory hierarchy cache and main memory, WRITE THROUGH results in more write cycles to main memory than WRITE BACK.

(a) Only S1 (b) Only S2
(c) Only S1 and S2 (d) None of these

Q.24 A dynamic RAM has a memory cycle time of 64 nsec. It has to be refreshed 100 times per msec and each refresh takes 100 nsec. What percentage of the memory cycle time is used for refreshing?

(a) 10 (b) 6.4
(c) 1 (d) 0.64

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.

Q.36 **Statement (I):** A memory module presents a specific memory interface to the processor or other unit that references memory.
Statement (II): Memory module contains buffer registers for the address and data.

Q.37 **Statement (I):** LRU (Least Recently Used) replacement policy is not applicable to direct mapped caches.
Statement (II): A unique memory page is associated with every cache page in direct mapped caches.

Q.38 **Statement (I):** Most personal computers use static RAMs for their main memory.
Statement (II): Static RAMs are much faster than dynamic RAMs.

Q.39 **Statement (I):** Associative memory is fast memory.
Statement (II): Associative memory searches by content and not by accessing of address.

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Answers Memory Organization and IO Organization

1. (d)	2. (a)	3. (d)	4. (a)	5. (a)	6. (d)	7. (a)	8. (b)	9. (b)
10. (d)	11. (b)	12. (d)	13. (d)	14. (a)	15. (a)	16. (c)	17. (a)	18. (c)
19. (d)	20. (b)	21. (b)	22. (b)	23. (b)	24. (c)	25. (a)	26. (c)	27. (a)
28. (a)	29. (b)	30. (c)	31. (c)	32. (b)	33. (b)	34. (d)	35. (a)	36. (a)
37. (d)	38. (d)	39. (a)						

Explanations Memory Organization and IO Organization

1. (d)

An interrupt is a signal from a device attached to a computer or from a program within the computer that causes the main program that operates the computer to stop and figure out what to do next. After the interrupt signal is sensed, it may change state of interrupted process to 'blocked' and schedule another process.

2. (a)

FIFO policy for page replacement used.
Access 100 distinct pages by taking some example: 2 3 4 5 6 7 8 9
So by loading it get

5
4
3
2

= 4 page fault,

9
8
7
6

= 4 page fault

and now access these page in reverse so

9 8 7 6 — So no page fault for these; 5 4 3 2 — page fault for these

9
8
7
6

5
4
3
2

4 page fault

So, total = 4 + 4 + 4 = 12 page fault
For 8 pages = 2 × 8 – 4 = 12
So, for n pages = 2n – 4
So, for 100 pages = 2 × (100) – 4 = 196

3. (d)

Assume,

Tag	Set	Word
12	8	4

Here k = 4

⇓ when associativity doubled

Tag	Set	Word
13	7	4

- Since, tag bits have been changed thus width of a Tag comparator changes.
- Since, width of set bits changed thus width of a set index decoder.
- Width of multiplexor change since k changes.

4. (a)

Temporal locality says that recently executed instruction is likely to be executed very soon.

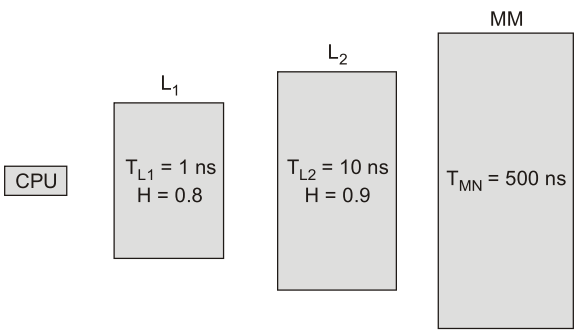
5. (a)

System which has lot of crashes, data should be written to the disk as soon as possible thus, write through cache is preferable.

6. (d)

Principle of locality states that many instruction in localized areas of the programs are executed repeatedly during short time period and the remainder of the program is accessed relatively less frequently. This is where use of cache comes into existence.

7. (a)



$T_{avg} = 0.8 \times 1 + 0.2 \times 0.9 \times (1 + 10) + 0.2 \times 0.1 \times 511$
$= 0.8 + 1.98 + 10.22 = 13$ ns

8. (b)

$$T \geq 1.2\, T_c = 120$$
$$T = H.T_c + (1 - H)(T_m)$$
$$T = H.100 + (1 - H)(1200)$$
$$T = 100H + 1300 - 1200H$$
$$T = 1200 - 1200\, H \geq 120$$
$$1200\, H = 1200 - (120)$$
$$H = \frac{1200}{1200} - \frac{(120)}{1200}$$
$$H = 1 - 0.1 = 0.9$$
$$\text{Hit Ratio} = 90\%$$

9. (b)

Average access time
= avg. seek time + avg. rotational latency + avg. transfer time

Here, for 1 round $= \frac{60\,\text{sec}}{n} = \frac{60{,}000}{n}$ msec

$\therefore$ Average rotational latency $= \frac{60{,}000}{2n}$

Also : 32×512 bytes = 1 track $= \frac{60{,}000}{n}$ msec

$\therefore$ 8 k byte $= \frac{60{,}000 \times 8 \times 2^{10}}{n \times 32 \times 512}$

$= \frac{60{,}000}{2n}$ msec

So, $\frac{60000}{2n} + \frac{60000}{2n} + 10 = 20$

$\therefore$ $n = 6000$ rpm

10. (d)

Maskable interrupt is one which can be delayed or rejected due to non-urgency when the microprocessor is busy.
If the instruction execution program is already written at a particular fixed location, then it is called vectored instruction.

11. (b)

Read access time
$= HT_c + (1 - H)(T_c + T_m)$
$= 0.9 \times 100 + 0.1 \times (100 + 1000)$nsec $= 200$ nsec.
Total access time
$= (0.8 \times 200 + 0.2 \times 1000)$nsec $= 360$ nsec.

12. (d)

Number of blocks $= \frac{4K}{64} = 64$

Number of sets $= \frac{64}{4} = 16$

$\Rightarrow$ 4 bits for SET
Each block has 64 words
$\Rightarrow$ 6-bits required for word.

Tag	Set	Word
	4-Bits	6-Bits

13. (d)

Disk is the IO device attached externally to the processor. Therefore, disk requires a device driver.

14. (a)

Number of surfaces (on which data can be stored)
$= 6 \times 2$
Each surface can hold
= Number of tracks $\times$ Number of sectors per track $\times$ Size of sector
$= 200 \times 50 \times 512$
Storage capacity $= 200 \times 50 \times 512 \times 12$ B