ELECTRICAL ENGINEERING DRDO

PRACTICE SET-1

Q.1:- The resistance of a strip of copper of rectangular cross-section is 2Ω. A metal of resistivity twice that of copper is coated on its upper surface to a thickness equal to that of copper strip. The resistance of composite strip will be

(a) 6Ω (b) 4/3Ω (c) 3/2Ω (d) 3/4Ω

Q.2:- The electric field lines and equipotential lines

(a) Are parallel to each other.
(b) Are one and the same.
(c) Cut each other orthogonally.
(d) Can be inclined to each other at any angle.

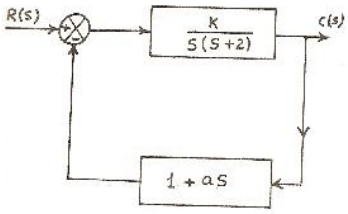
Q.3:- For an SCR, di/dt protection is achieved through the use of

(a) R in series with SCR.
(b) L in series with SCR.
(a) RL in series with SCR.
(c) RLC in series with SCR.

Q.4:- In a linear system, an input of 5 sin wt produces an output of 10 cos wt. The output corresponding to input 10 cos wt will be equal to

(a) + 5 sin wt (b) - 5 sin wt (c) + 20 sin wt (d) – 20 sin wt.

Q.5:- For the system shown in figure, with a damping ratio § of 0.7 and an undamped natural frequency wn of 4 rad / sec, the values of K and are



(a) K = 4, a = 0.35
(b) K = 8, a = 0.455
(c) K = 16, a = 0.225

(d) K = 64, 0.9

Q.6:- A single instruction to clear the lower four bits of the accumulator I 8085 assembly language is:

(a) XRI OHF (b) ANI FOH (c) XRI FOH (d) ANI OFH.

Q.7:- The p-type substrates in a conventional pn-junction isolated integrated circuit should be connected to:

(a) Nowhere, i.e., left floating.
(b) A dc ground potential.
(c) The most positive potential available in the circuit.
(d) The most negative potential available in the circuit.

Q.8:- The velocity of electromagnetic ratio waves is

(a) 3 x $10^6 \mathrm{m/s}$
(b) 3 x $10^8 \mathrm{m/s}$
(c) 3 x $10^{10} \mathrm{m/s}$
(d) 3 x $10^{12} \mathrm{m/s}$

Q.9:- A certain 8- bit microprocessor executes "SUB A, B" by loading B to the ALU, then loading A to the ALU, Subtracting A from B, and storing the result in B. Which of the following instructions would cause the ZERO flag to be set?

(a) SUB – (X), (X) +
(b) SUB)X), (X) +
(c) SUB – (X), (X)
(d) all of the above

Q.10:- which of the following induction motor will have the least shaft diameter?

(a) 20 HP, 2880 rpm
(b) 20 HP, 1440 rpm
(c) 20 HP, 960 rpm
(d) 20 HP, 730 rpm

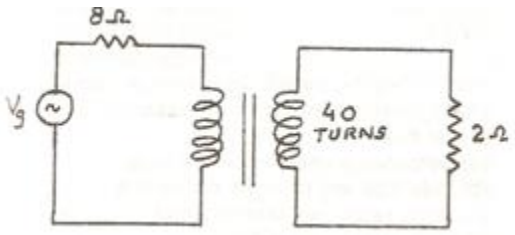
Q.11:- In 'plasma' state a gas

(a) (a) loses electrical conductivity
(b) (b) attracts moisture
(c) (c) becomes perfect dielectric medium

(d) (d) conducts electricity

Q.12:- If the secondary winding of the ideal transformer shown in the figure below, has 40 turns, the number of turns in the primary winding for maximum power transfer to the 2 ohm resistor will be

IDEA TRANSFORMER



(a) 20 (b) 40 (c) 80 (d) 160

Q.13:- A 6 pole 3-phase wound-rotor induction machine is driven by another machine at 1800 rpm. The rotor of the induction machine is connected to a 50Hz system. If the mechanical rotation of the rotor is in the same direction as the rotor winding flux rotation, then frequency of the stator voltage will be

(a) 50Hz (b) 140 Hz (c) 150 Hz (d) 200 Hz

Q.14:- A universal motor runs at

(a) Higher speed will dc supply and with less sparking.
(b) Higher speed with ac supply with less sparking.
(c) Same speed both ac and dc supplies.
(d) Higher speed with ac supply but with increased sparking at the brushes.

Q.15:- Two 550 kVA alternator operate in parallel to supply the following loads

I. 250 KW at 0.95 p.f. lagging
II. 100 KW at 0.85 p.f. leading

One machine is supplying 200 KW at 0.9 p.f. lagging. The p.f. of other machine must be

(a) 0.89 leading (b) 0.95 leading (c) 0.95 lagging (d) 0.89 lagging

Q.16:- In a 110 volts compound generator, the armature, shunt and series windings are 0.06 ohm, 27.5 ohm and 0.04 ohm respectively. The load consists of 200 lamps; each rated at 55 W, 110 V. find the total e.m.f. when the machine is connected for long shunt operation.

(a) 12 V (b) 72 V (c) 100 V (d) 120 V

Q.17:- 1 Bagasse is

(a) Low quality coal.
(b) A fuel consisting of wood.
(c) Fibrous portion of sugarcane left after extracting the juice.
(d) A kind of rice straw.

Q.18:- The copper armature winding of a motor is subjected to an operating temperature of 80°C. The room temperature is 20° C. The percentage change in resistance of the armature winding from cold staring condition to normal running will be nearly:

(a) 10% (b) 16% (c) 20% (d) 24%

Q.19:- Magnetic flux density at a point distance R due to an infinitely long linear conductor carrying a current is given by

(a) B = $\frac{1}{2\mu\ \pi R}$ (b) B = $\frac{\mu\ I}{2R}$

(c) B = $\frac{\mu\ I}{2\ \mu\ R}$ (d) B = $\frac{\mu\ I}{2\ \pi\ R2}$

Q.20:- A zener diode works on the principle of

(a) Tunneling of charge carriers across the junction.
(b) Thermionic emission.
(c) Diffusion of charge carriers across the junction.
(d) Hoping of charge carriers across the junction.

Q.21:- Two resistance 100Ω ± 5Ω ± 15Ω are connected in series. If the errors are specified as standard deviations, the resultant error will be

(a) ± 10Ω (b) ± 10.6Ω (c) ± 15.8Ω (d) ± 20Ω

Q.22:- The unit impulse response of a system is given as c (t) = -4^{e-t} +6e^{-2t}. The step response of the same system for ≥0 is equal to

(a) − 3^{e-2t} +4e^{-t}+1

(b) $-3^{e-2t}+4e^{-t}-1$
(c) $-3^{e-2t}+4e^{-t}-1$
(d) $-3^{e-2t}+4e^{-t}-1$

Q.23:- Which of the following statements is true?

(a) ROM is a Read/Write memory.
(b) PC points to the last instruction that was executed.
(c) Stack works on the principal of LIFO.
(d) All instructions affect the flags.

Q.24:- If a transistor is operation with both of its junctions forward biased, but with the collector forward bias greater than the emitter-base forward bias, then it is operating in ht

(a) Forward active mode.
(b) Reverse saturation mode.
(c) Reverse active mode forward saturation mode.
(d) Forward saturation mode.

Q.25:- Which type of transmission line will have the maximum value of characteristic impedance?

(a) Open wire line.
(b) Twin lead line.
(c) Coaxial cable.
(d) All have same impedance.

Q.26:- The ALU of a microprocessor performs operations of8-bit two's complement operands. What happens the operation $7A_{16} - A2_{16}$ is performed?

(a) Result = $D8_{16}$'Overflow and negative flags set.
(b) Result = $D8_{16}$' Negative flag is set.
(c) Result = $D8_{16}$'No flags set.
(d) Result = 28_{16}'overflow flag set.

Q.27:- Efficiency of a plant is secondary consideration for

(a) Base load power plants.
(b) Peak load power plants.
(c) Both peak loads as well as base load power plants.
(d) Neither peak load nor base load power plants.

Q.28:- An undesirable side effect of motional inductance of large conduction specimens is

(a) Skin effect (b) hysteresis (c) eddy currents (c) dielectric loss

Q.29:- if the rated voltage from the power lines is applied to the primary of a single-phase transformer which is operated on no-load, then

(a) Both input voltage and current are sinusoidal.
(b) Both input voltage and current are non-sinusoidal.
(c) Input voltage is non-sinusoidal and input current sinusoidal.
(a) D input voltage is sinusoidal and input current is non sinusoidal.

Q.30:- "In all cases of electromagnetic induction, an induced voltage will cause a current to flow in a closed circuit in such a direction that the magnetic field which is caused by that current will oppose the change that produces the current" is the original statement of

(a) Lenz's law
(b) Faraday's law of magnetic induction.
(c) Fleming's law of induction
(d) Ampere's law

Q.31:- The sator and rotor pole number may be different in a

(a) Pole changing induction motor.
(b) Reluctance motor.
(c) Repulsion motor.
(d) Synchronous motor.

Q.32:- Match List-1 with List-2 and select the correct answer using the codes given below the lists:

List-1 (Parts of a tubogenrator used in thermal power plants		List-2 (Materials from which these parts are made)	
(a) A.	Steel core	1.	Copper
(b) B.	Rotor core	2.	Copper alloy
(c) C.	Stator windings	3.	Silicon steel
(d) D.	Slip rings	4.	Mild steel
		i. 5.	Aluminum

Codes:-

(a)	A	B	C	D
	3	5	2	1

(b)	A	B	C	D
	4	5	1	2
(c)	A	B	C	D
	4	3	1	2
(d)	A	B	C	D
	3	4	1	2

Q.33:- The type of dc generator used for arc welding purposes is a

(a) Series generator.
(b) Shunt generator.
(c) Cumulatively compounded generator.
(d) Differentially compound generator.

Q.34:- In power station practice "spinning reserve" is

(a) Reserve generating capacity that is in operation but not in service.
(b) Reserve generation capacity that is connected to bus and ready to take the load.
(c) Reserve generating capacity that is available for service but not in operation.
(d) Capacity of the part of the plant that remains under maintenance.

Q.35:- A load that has a resistance of 10 ohms is to be connected to a supply that has a constant voltage of 120 volts. If it is desired that the current to the load be varied from 3 to 5 amperes, what are the resistance and the current rating of the series rheostat that permit this variation?

(a) (a) 5 ohms, 5 A (b) 10 ohms, 10 A
(b) (c) 20 ohms, 10 A (d) 20 ohms, 10 A

Q.36:- Maxwell's divergence equation for the magnetic field is given by

(a) (a) $\nabla \times B = 0$ (b) $\nabla . B = 0$
(b) (c) $\nabla \times B = \rho$ (d) $\nabla . B = \rho$

Q.37:- When a line commutated converter operates in the inverter mode

(a) It draws both real and reactive power from the A.C. supply.
(b) It delivers both real and reactive power to the A.C. supply.
(c) It delivers real power to the A.C. supply.
(d) It draws reactive power from the A.C. supply.

Q.38:- Match List-1 with List-2 and select the correct answer using the codes given below the lists:

List-1 (Parameter measured	List-2 (Bridge)
A. Audio frequency	1. Maxwell bridge
B. High Q inductor	2. Hay bridge
C. Dielectric loss	3. Wien bridge
D. Low Q inductor	4. Schering bridge

Codes:

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

Q.39:- Match List-1 with List-2 and select the correct answer using the codes given below the lists:

List-1 (Time functions)	List-2 (Laplace transforms)
A. E^{-2} (t-2)	1. $\frac{2}{S^2}$
B. $\frac{d(t^2)}{dt}$	2. $\frac{1 \quad e^{-2}s}{S+2}$
C. t / 2	3. $\frac{1}{2s^2}$
	4. $\frac{1}{2s}$

Codes:

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

(d) A B C
3 1 4

Q.40:- What is the distance of the following code?

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

Q.41:- The common-emitter short-circuit current gain of a transistor

(a) Is a monotonically increasing of the collector currentI_c.
(b) is a monotonically decreasing function I_c.
(c) Increases with I_c for low I_c , reaches a maximum, and then decreases in I_c .
(d) is not a function of I_c.

Q.42:- Which of the following is circularly polarized antenna?

(a) Helical (b) yogi.uda (c) Small circular loop (d) Parabolic reflector

Q.43:- A single instruction to clear the lower four bits of the accumulator in 8085 assembly language is:

(a) XRI OFH (b) ANI FOH (c) XRI FOH (d) ANI OFH

Q.44:- Which of the following equipment would need high starting torque as compared to running torque?

(a) Lathe machine
(b) Electric Locomotive
(c) Centrifugal pump

(d) Reciprocating compressor.

Q.45:- All of the following comparisons between metals and metal alloys and ceramics are true except

(a) ceramic compounds crystallize more slowly then metallic compounds
(b) ceramic compounds have higher melting temperatures than metallic compounds
(c) Metallic compounds are better conductors or current than ceramic compounds at higher temperatures.
(d) Ceramic compounds are able to resist greater tensile stresses than metallic compounds at room temperatures.

Q.46:- Two 3-phase transformers are to be connected for parallel operation. Which one of the following arrangements is impossible?

(a) Transformer A: primary Y; secondary Y

Transformer B: primary Δ ; secondary Δ

(b) Transformer A: primary Δ ; secondary Y

Transformer B: primary Δ ; secondary Δ

(c) Transformer A: primary Y ; secondary Δ

Transformer B: primary Δ ; secondary Δ

(d) Transformer A: primary Δ ; secondary Δ

Transformer B: Primary Δ ; secondary Δ

Q.47:- A centre zero ammeters connected in the rotor circuit of a 6-pole 50 Hz induction motor makes 30 oscillations in one minute. The rotor speed is

(a) 970 (b) 990 (c) 1010 (d) 1030

Q.48:- which of the following capacitor start split-phase induction motor will have the largest value of capacitance?

(a) ½ H.P., 3450 rpm
(b) ½ H.P., 1725 rpm
(c) ½ H.P. , 1140 rpm
(d) ¾ H.P., 1140 rpm.

Q.49:- The most appropriate operating speed in rpm of generators used in Thermal, Nuclear and Hydro-power plants would respectively be:

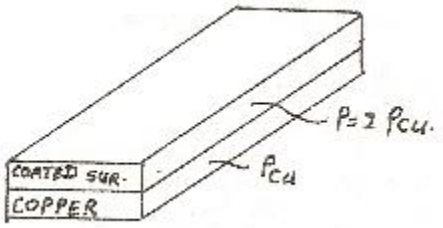
(a) 3000, 300 and 1500
(b) 3000, 3000 and 300
(c) 1500, 1500 and 3000
(d) 1000,900 and 750

Q.50:- A 220 V dc machine has an armature resistance o f 1-ohm. If the full load current is 20A, the difference in the induced voltage when the machine is running as a motor, and as a generator is

(a) 20 V (b) zero (c) 40 V (d0 50 V

Solution:-

1:-(b) Copper and coated metal strips have resistance of 2 ohms and 4 ohms respectively. These two strips are in parallel. Hence the resistance of the composite strip will be (2x4) / (2+4) =4/3 ohms.



2:-(c) Since no electric can exist along any surface, all points of which are at the same potential, electric field lines and equipotential lines are orthogonal to each other.

3 :-(b) For an SCR, di/dt protection is achieved through the used of L in series with SCR. A snubber circuit connected across an SCR is to suppress dv / dt.

4 :-(d) Sin wt→ −Cos wt

Differentiating

Cos wt→ −2 Sin wt

∴ An input of 10 Cos wt will cause a

Response of – 20 Sin wt.

5:- (c) M (s) = $\frac{G\ (s)}{1+G\ (s)\ H\ (s)}$

= $\frac{K\ /\ s\ (s+2)}{1+(1+as)K/s(s+2)}$

The changed equation is

s (s+2) + K (1 + as) = 0 or s^2 + s (2+ak) + k =0

Compare with s^2+2 δ_n s+ $w_n{}^2$ = 0

∴ K = $w_n{}^2$ = 4^2 = 16;

$2\ \delta w_n$ = (2+ak)

$\therefore$ a= $\frac{2\times0.7\times4-2}{16}$ = $\frac{3.6}{16}$ = 0.225

6:- (b) A single instruction to clear the lower four bits of the accumulator in 8085 assembly language is ANI FOH.

7:- (d) it should be connected to the most negative potential available in the circuit.

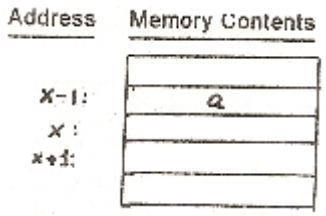
8:- (b) The velocity of electromagnetic wave is 3 x 10^8 m / s.

9:- (a) Note that

(X) + signifies "locate the operand at location X, and then increment X by 1."

– (X) signifies "decrement X by 1, and then locate the operand at location old – X minus one."

Following is a diagram of a section of linear memory containing the location X.



Consider the instruction:

SUB – (X), (X) +

Observe that at both times the same operand, namely a, is being accessed. Since a – a = 0 the zero flag will be set.

10:- (a) The horsepower is proportional to the product of rpm (N) and torque (T)

$$HP \propto N.T.$$

Since the horsepower of all the motors is the same, the motor having highest rpm (2880 in this case) will have least torque. Diameter of the shaft depends on torque, therefore, 20 HP, 2880 rpm motor will have the least diameter of shaft.

11:- (d) in plasma state a gas is fully ionized and it conducts elasticity.

12: (c) For maximum power transfer to 2 ohm resistor, the reflected resistance in the primary circuit should be 8 ohm.

Therefore,

$\frac{N_1}{N_2}$ = 2 so that $R_2{}'$ = $(\frac{N_1}{N_2})^2$ x R_2

Or R_2 = 2^2 x 2 8 ohm

Thus, N_1 = 2 x 40 = 80 turns.

13:- (b) P = 6, Nr =1800 rpm, f_2 = 50 Hz

Let the stator voltage frequency be f.

Then, f_2 = sf.

Also, $\frac{120\ f}{P}$ = N_s

Or $\frac{120 \times 50}{6_s}$ = N_s

Or N_s = $\frac{1000}{s}$, s being slip

Or s = $\frac{N_s - N_r}{6_s}$ or N_s (1 – s) = N_r

Or N_s – N_s . s = N_r or $N_s - N_s \frac{1000}{N_s}$ = N_r

Or N_s – N_r + 1000 =1800+1000=2800

∴ f = $\frac{2800 \times 6}{120}$ = 140 Hz.

14:- (a) A universal motor runs at higher speed with DC supply and with less sparking.

15:- (a) Total P = 250 + 100 = 350 kW

Total Q = 250 tan $\cos^{-1}$ 0.95 – 100 tan $\cos^{-1}$ 0.85

= 250 x 0.3287 – 100 x 0.6197

= 82.171 – 61.97 = 20.196 kVAR

Q_1 = 200 tan $\cos^{-1}$ 0.9 96.86 kVAR

Q_2 = the reactive power of the other machine is 20.196 – 96086 = −76.67 kVAR

∴ The second machine will operate at leading

p.f. P_2 of this machine is

350 – 200 = 150 kW

∴ Cos ϕ_2 = tan $\cos^{-1} \frac{76.67}{150}$

= 0.890 leading.

16:- (d) r_a = 0.06 ohm

r_{sh} = 27.5 ohm

r_s = 0.04

Total load current.

I_L = 200 x $\frac{55}{110}$ = 100 A

I_{sh} = $\frac{110}{27.5}$ = 4 A.

$I_a = I_L + I_{sh}$ = 100 + 4 = 104A

emf = 110 + 104 (0.06 + 0.04) = 120.4 V.

17:- (c) Bagasse is fibrous portion of sugarcane left after extracting the juice.

18:- (c) For the present problem, the readers should consider armature as a copper conduction through which the current flows.

We know that for copper

α = 0.00393 (at 20°C)

Hence, $R_{80} = R_{20}$ [1 + α (80 – 20)]

= $R_{20} + R_{20} . \alpha$ X 60

$\therefore \frac{R_{80} - R_{20}}{R_{20}}$ =0.00393 x 60 = 2.358

Hence percentage change in the value of the resistance = 23.58%.

19:- (c) This is a simple and standard derivation to show that magnetic flux density B around an infinitely long straight filamentary wire carrying a current I is μ I / 2πR where R is the perpendicular distance of the point of intersection form the wire.

20:- (a) In Zener diode the carriers are accelerated by electric field. When they collide with atoms they ionize the atoms due to their kinetic energy. Hence an avalanche break down occurs due to the large increase in the number of carriers.

21:- (c) R_1 = 100 ohm $\pm$ 5 ohm,

R_2 = 150 ohm $\pm$ 15 ohm

R = $R_1 + R_2$

The errors are specified at standard deviations or are probable errors. In this case,

R = $\pm\sqrt{{R_1}^2 + {R_2}^2}$

= $\pm\sqrt{5^2 + 15^2}$

= $\pm\sqrt{250}$

= ± 15.8 ohms.

22:- (b) The unit step response is the integral of unit impulse response.

∴ Unit step response

= $\int_0 [-4e^{-t} + 6e^{-2t}]\, dt$

$= 4e^{-t} - 3e^{-2t}\ I^{t\infty}$

$= 4e^{-t} - 3e^{-2t} - 1$

23:- (c) Stack works on the principle of LIFO is the true statement.

24:- (b) It is operating in the reverse saturation mode.

25:- (b) The characteristic impedance Zo, for various types of transmission line sins given below:

Transmission Line	**Zo**
Open – wire line	300 – 600 Ω
Twin – lead line	250 – 300 Ω

Coaxial cable	50 – 75 Ω	

26:- (a)

7 A	0111 1010	0111 1010
−A2	−1010 0010	+ 0101 1110
		1101 1000

Result = $D8_{16}$.

Sign bit = 1, so negative flag set. The sign of the result is the same as the sign of the number subtracted; thus. Overflow flag set.

27:- (b) Main purpose of peak load plant is to meet the peaked demand. Such plants normally run for short durations and, therefore, their efficiency is a secondary consideration.

28:- (c) When a conductor is moved towards the north pole of a bar magnet, if will experience a change of magnetic flux as a result of which there will be an induced emf. This emf will give rise to an induced current in the conductor, in a direction (determined by Lenz's law) that will oppose the movement of the conductor. Such currents are called eddy currents.

In general, eddy currents occur in conductors that experience a change of flux. This flux change can be due either to the mechanical motion in a magnetic field as in the armature of a motor, or to a changing current in the wires wound around the soft iron core of a transformer. In both cases, eddy currents cause $i^2 R$ losses due to heating. These can be minimized by laminating the iron core, i.e., building it up with thin sheets covered by a thin coating of insulating varnish. This reduces the eddy currents.

29:- (d) Magnetizing current is usually non-sinusoidal at the flux density values normally used; and under no load condition, the total current comprises magnetizing current and core loss component correct.

30:- (a) Lenz's law

30:- (b) Reluctance motor.

32:- (d) A - 3, B – 4, C – 1, D – 2.

33:- (d) As the terminal voltage should fall with increase in the arc current for welding work, the differentially compounded generator is quite suited for this purpose.

34:- (b) In power station practice "spinning reserve" is to reserve generating capacity that is connected to bus and ready to take the load.

35:- (c) The 10 ohm load when connected to 120 V supply with take a current of 120/10 =12A without rheostat in the circuit. Since it is desired to restrict the current flow through the load at 3 to 5 amperes, the voltage drop in the load will be

3 x 10 = 30 volts at 3 amperes, and

5 x 10 =50 volts at 5 amperes

When the voltage drop across the load is 30 V, the voltage drop in the rheostat must be120 – 30 = 90 volts. Since the same current flows through the rheostat, the resistance of the rheostat must be 90 / 3 = 30 ohms.

When the voltage drop across the load is 50 V, the voltage drop in the rheostat must be 120 – 50 = 70 volts. Since the same current flows through the rheostat, the resistance of the rheostat must be 70 /5 =14 ohms. Thus rating of rheostat must be 30 ohms and 5 amperes.

36:- (b) No explanation needed something standard and evident as the net magnetic flux through any closed surface is always zero. $\nabla . B = 0$

37:- (c) A line commutated converter operates, in the rectifying mode converting ac to dc for the first 0° to 90° and in the inverting mode for phase angels 90° to 180°. When the dc voltage is negative power flow is from dc to ac and the converter functions as inverter. As dc power is fed back it is real power.

38:- (b) A – 3, B – 2, C – 4, D - 1

39:- (a) A – 2, B – 1, C – 3

40:- (a) Two

41:- (c) The common emitter short-circuit current gain of transistor increases with I_c for low $I_{c'}$ reaches a maximum, and then decreases with further increase in $I_{c.}$

42:- (a) only a helical antenna is the circularly polarized antenna.

43:- (b) ANI FOH

An accumulator is a resister in which the result of an arithmetic or logic operation is formed.

44:- (b) only locomotive needs starting torque more than the running torque

45:- (d) Ceramic materials are more brittle than metals. Ceramic materials are able to resist enormous shear stresses. The tension and compression strength of the ceramic materials are not comparable due to the enormous shear resistance. Under a tensile load the stress will be

concentrated at cracks and flaws in the ceramic material. A more ductile material will be able to lower the stress concentration through plastic deformation. However, if plastic deformation cannot occur due to high shear resistance, the stress concentration will continue to increase as the load increases. The crack will extend and a brittle fracture will take place.

46:- (b) Even (c) is possible because we can have the phase group as yd 1 and Dy 1 or yd 11 and Dy 11. (b) is impossible because there shall be a phase difference of 30° in the voltages of the corresponding phases of the two-transformers on the secondary side.

47:- (b) Rotor frequency f_2 = 0.5 H;

$f_2 = sf$

$s = \frac{0.5}{50} = 0.01$

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

$N_r = N_s\ (1 - s)$

$= 1000\ (1 - 0.01) = 990$ rpm

48:- (d) Out of the given range of motors, motor at (d) will require highest torque. Therefore, capacitor in the auxiliary winding for this motor would have the largest value.

49:- (b) Thermal power plant generators are invariably high speed machines. Nuclear power plants also use similar machines with the only difference in the source of energy. Hydroelectric power plants are invariably low speed machines therefore, choice (b) is appropriate.

50:- (c) Motor: $I_a = I_L - I_{sh'}$

$= E_{bm} = V - (I_L - I_{sh})\ r_a$

$= 220 - (20 - I_{sh})$

Gen.: $I_a = I_L + I_{sh'}$

$= E_{by} = V + (I_L + I_{sh})\ r_a$

$= 220 + (20 + I_{sh})$

$= E_{by} - E_{bm} = 40$ V.