SSC JE ENGLISH MEDIUM PLANNER

ELECTRICAL ENGINEERING

Chapterwise & Sub-topicwise SOLVED PAPERS

Chief Editor
A. K. Mahajan
Compiled by
Er. Santosh Kumar Yadav, Er. Anil Kumar Yadav
Computer Graphics
Balkrishna, Charan Singh
Editorial Office
12, Church Lane Prayagraj-211002
Mob. : 9415650134
Email : yctap12@gmail.com
website : www.yctbooks.com/www.yctfastbook.com

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SSC Junior Engineer Paper Syllabus

ELECTRICAL ENGINEERING

The Examination will be conducted in two stages:

A. Paper-I (Pre) (200 marks)

B. Paper-II (Mains) (300 marks)

Total Written Test (500 marks)

Written Test :

Paper	Mode of Examination	Subject	Number of Questions/Max. Marks	Duration & Timing
Paper-I Objective type	Computer Based Examination	(i) General Intelligence & Reasoning (ii) General Awareness (iii) General Engineering (Electrical)	50/50 50/50 100/100	2 Hours
Paper-II Objective Type	Computer Based Examination	General Engineering (Electrical)	100/300	2 Hours

There will be **negative marking equal to one-third (1/3) of the marks** alotted to the question for each wrong answer in Paper-I & Paper-II.

SSC JE Syllabus of Examination:

- **Indicative Syllabus:** The standard of the questions in Engineering subjects will be approximately of the level of Diploma in Engineering (Civil/ Electrical/ Mechanical) from a recognized Institute, Board or University recognized by All India Board of Technical Education. All the questions will be set in SI units. The details of the syllabus are given below.

Paper-I

- **General Intelligence & Reasoning:** The Syllabus for General Intelligence would include questions of both verbal and non-verbal type. The test may include questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgement, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series etc. The test will also include questions designed to test the candidate's abilities to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions.
- **General Awareness:** Questions will be aimed at testing the candidate's general awareness of the environment around him/her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighbouring countries especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.
- **General Engineering Electrical**
- Basic concepts, Circuit law, Magnetic Circuit, AC Fundamentals, Measurement and Measuring instruments, Electrical Machines, Fractional Kilowatt Motors and single phase induction Motors, Synchronous Machines, Generation, Transmission and Distribution, Estimation and Costing, Utilization of Electrical Energy, Basic Electronics.

Detailed Syllabus (JE Electrical Engineering)

Basic concepts:

- Concepts of resistance, inductance, capacitance, and various factors affecting them. Concepts of current, voltage, power, energy and their units.

Circuit law :

- Kirchhoff's law, Simple Circuit solution using network theorems.

Magnetic Circuit :

- Concepts of flux, mmf, reluctance, Different kinds of magnetic materials, Magnetic calculations for conductors of different configuration e.g. straight, circular, solenoidal, etc. Electromagnetic induction, self and mutual induction.

AC Fundamentals :

- Instantaneous, peak, R.M.S. and average values of alternating waves, Representation of sinusoidal wave form, simple series and parallel AC circuits consisting of R.L. and C, Resonance, Tank Circuit. Poly Phase system – star and delta connection, 3 phase power, DC and sinusoidal response of R-Land R-C circuit.

Measurement and measuring instruments :

- Measurement of power (1-phase and 3-phase, both active and reactive) and energy, 2 wattmeter method of 3 phase power measurement. Measurement of frequency and phase angle. Ammeter and voltmeter (both moving coil and moving iron type), extension of range wattmeter, Multimeters, Megger, Energy meter AC Bridges. Use of CRO, Signal Generator, CT, PT and their uses. Earth Fault detection.

Electrical Machines :

- (a) D.C. Machine – Construction, Basic Principles of D.C. motors and generators, their characteristics, speed control and starting of D.C. Motors. Method of motor's braking, Losses and efficiency of D.C. Machines. (b) 1-phase and 3-phase transformers – Construction, Principles of operation, equivalent circuit, voltage regulation, O.C. and S.C. Tests, Losses and efficiency. Effect of voltage, frequency and wave form on losses. Parallel operation of 1 phase / 3-phase transformers. Auto transformers. (c) 3-phase induction motors, rotating magnetic field, principle of operation, equivalent circuit, torque-speed characteristics, starting and speed control of 3-phase induction motors. Methods of braking, effect of voltage and frequency variation on torque-speed characteristics.

  Fractional Kilowatt Motors and Single Phase Induction Motors : Characteristics and applications.

Synchronous Machines –

- Generation of 3-phase e.m.f. armature reaction, voltage regulation, parallel operation of two alternators, synchronizing, control of active and reactive power. Starting and applications of synchronous motors.

Generation, Transmission and Distribution –

- Different types of power stations, Load factor, diversity factor, demand factor, cost of generation, inter-connection of power stations. Power factor improvement, various types of tariffs, types of faults, short circuit current for symmetrical faults. Switchgears – rating of circuit breakers, Principles of arc extinction by oil and air, H.R.C. Fuses, Protection against earth leakage / over current, etc. Buchholtz relay, Merz-Price system of protection of generators & transformers, protection of feeders and bus bars. Lightning arresters, various transmission and distribution system, comparison of conductor materials, efficiency of different system. Cable – different type of cables, cable rating and derating factor.

Estimation and costing :

- Estimation of lighting scheme, electric installation of machines and relevant IE rules. Earthing practices and IE Rules.

Utilization of Electrical Energy :

- Illumination, Electric heating, Electric welding, Electroplating, Electric drives and motors.

Basic Electronics :

- Working of various electronic devices e.g. P-N Junction diodes, Transistors (NPN and PNP type), BJT and JFET. Simple circuits using these devices.

SSC JE Electrical Engineering Previous Papers Analysis Chart

S.L.	Exam NAME	EXAM DATE/TIME	No. of Questions
Staff Selection Commission (SSC JE)			
1.	SSC JE Shift-III	09.10.2023	100
2.	SSC JE Shift-II	10.10.2023	100
3.	SSC JE Shift-III	11.10.2023	100
4.	SSC JE	16.11.2022	100
5.	SSC JE	15.11.2022	100
6.	SSC JE	14.11.2022	100
7.	SSC JE Shift-I	24.03.2021	100
8.	SSC JE Shift-II	24.03.2021	100
9.	SSC JE Shift-II	29.10.2020	100
10.	SSC JE Shift-II	10.12.2020	100
11.	SSC JE Shift-I	28.10.2020	100
12.	SSC JE Shift-I	26.09.2019	100
13.	SSC JE Shift-II	26.09.2019	100
14.	SSC JE Shift-I	29.01.2018	100
15.	SSC JE Shift-II	29.01.2018	100
16.	SSC JE Shift-I	27.01.2018	100
17.	SSC JE Shift-II	27.01.2018	100
18.	SSC JE Shift-I	25.01.2018	100
19.	SSC JE Shift-II	25.01.2018	100
20.	SSC JE Shift-I	24.01.2018	100
21.	SSC JE Shift-II	24.01.2018	100
22.	SSC JE Shift-I	23.01.2018	100
23.	SSC JE Shift-II	23.01.2018	100
24.	SSC JE Shift-I	22.01.2018	100
25.	SSC JE Shift-II	22.01.2018	100
26.	SSC JE Shift-I	04.03.2017	100
27.	SSC JE Shift-II	04.03.2017	100
28.	SSC JE Shift-I	03.03.2017	100
29.	SSC JE Shift-I	03.03.2017	100
30.	SSC JE Shift-II	02.03.2017	100
31.	SSC JE Shift-II	02.03.2017	100
32.	SSC JE Shift-II	01.03.2017	100
33.	SSC JE Shift-I	01.03.2017	100
34.	SSC JE	2015	100
35.	SSC JE Shift-I	2014	100
36.	SSC JE Shift-II	2014	100
37.	SSC JE	2013	100
38.	SSC JE	2012	100
39.	SSC JE Shift-I	2011	50
40.	SSC JE Shift-II	2011	50
41.	SSC JE	2010	50
42.	SSC JE	2009	40
43.	SSC JE	2008	44
44.	SSC JE	2007	38
		Total	**4072**

Highlights of SSC JE Electrical Engineering-2022

Chapter-1 BASIC CONCEPTS AND NETWORK THEORY

i. Basic Concept & Ohm's Law

1. In case of electrical energy, the joule is also expressed as the _____.

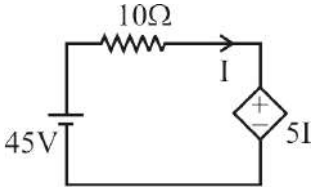
(a) newton-second (b) meter-second
(c) watt-second (d) joule-second

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The joule is the SI unit of energy a measure of the capacity to do work or generate heat.

$$1 \text{ Joule} = \text{One watt} - \text{second}$$

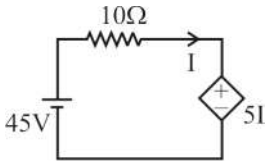
2. In the circuit shown below, the power delivered by the dependent voltage source is:



(a) 0 W (b) –15 W
(c) –45 W (d) 45 W

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Given that,



Applying KVL in loop-

$45 - 10I - 5I = 0$

$45 = 15I$

$I = \frac{45}{15}$

$I = 3\text{Amp}$

Power (P) = VI

Power delivered by the dependent voltage source

$= -15 \times 3 = -45\text{W}$.

3. The electrical pressure measured between any two points in an electrical circuit is called.....

(a) Energy (b) Resistivity
(c) Voltage (d) Work done

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The electrical pressure measured between any two points in an electric circuit is called voltage.

Voltage is also known as electric pressure, potential difference.

Potential difference-

$$V = \frac{W}{q} = \frac{\text{work}}{\text{charge}} \text{ Joule/Coulomb or volt}$$

Dimension : $[ML^2T^{-3}I^{-1}]$

4. In an electrical network, if the quantity of source is controlled by another voltage or current present in the circuit, such a source is called.....

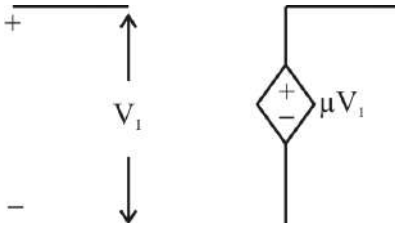
(a) Ideal source
(b) Non-ideal source
(c) Independent source
(d) Dependent source

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

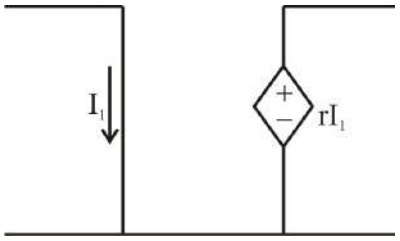
Ans. (d) : In an electrical network, if the quantity of a source is controlled by another voltage or current present in the circuit, such a source is called dependent source.

Type of dependent source-

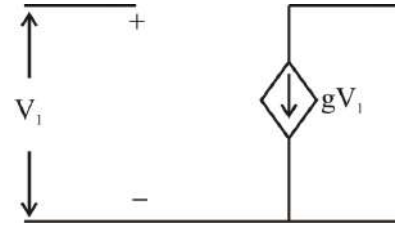
(i) Voltage- controlled voltage source (VCVS)



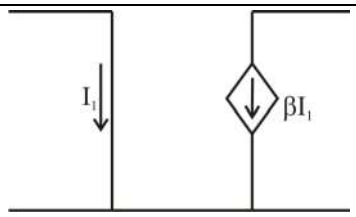
(ii) Current-controlled voltage source (CCVS)



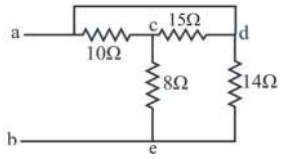
(iii) Voltage controlled current source (VCCS)



(iv) Current controlled current source (CCCS)



5. Find the equivalent resistance across terminal a-b:

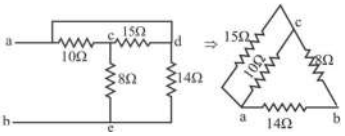


(a) 7Ω (b) 14Ω

(c) 20Ω (d) 28Ω

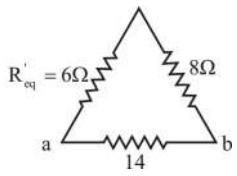
SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) :

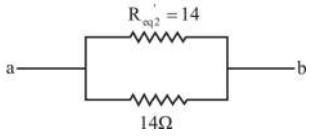


$$R'_{eq} = \frac{15\times10}{15+10} = 6\Omega$$

$\Downarrow$



$$R'_{eq2} = 6+8 = 14$$



$$R_{eq} = \frac{14\times14}{14+14} = 7\Omega$$

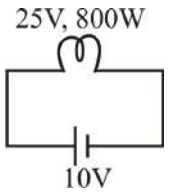
6. A 25 V, 800 W bulb is connected to a 10 V source. The power consumed by the bulb is .....

(a) 100 W (b) 400 W

(c) 128 W (d) 64 W

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) :

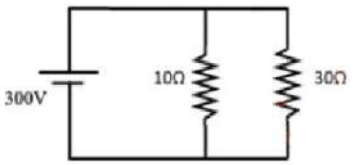


Resistance of bulb (R_b) $= \frac{V_b^2}{P_b} = \frac{(25)^2}{800} = \frac{25}{8\times4} = \frac{25}{32}$

Power consumed by the bulb (P)

$$= \frac{V^2}{R_b} = \frac{(10)^2}{25}\times32 = 4\times32 = 128\text{W}$$

7. The power consumed by the 30 Ω resistor is:



(a) 300 W (b) 3000 W

(c) 10 W (d) 9000 W

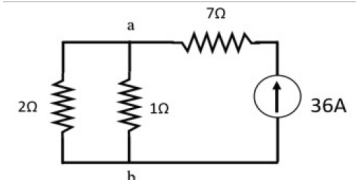
SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Voltage across 30Ω resistor = 300V

Power consumed by the 30 Ω resistor is-

$$P_{30} = \frac{(300)^2}{30} = 3000\text{W}$$

8. The current through the 2Ω resistor is:

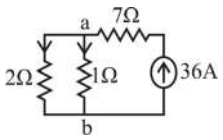


(a) 1A from a to b (b) 12A from a to b

(c) 25A from b to a (d) 10A from b to a

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :

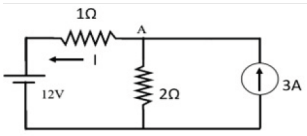


According to current division rule-

Current in 2Ω resistor ($I_{2\Omega}$) $= \frac{1}{2+1}\times36 = 12\text{A}$

$I_{2\Omega}$ = 12A (from a to b)

9. In the circuit shown below, the value of the current I is.....

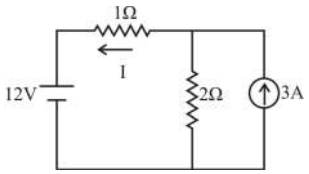


(a) 2A (b) –2A

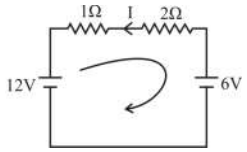
(c) 4A (d) 0A

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :



Convert current source to voltage source-



Applying KVL in loop-

$$I = -\frac{(12-6)}{1+2}$$

$\boxed{I = -2A}$

10. Find the electrical energy consumed in 10Ω resistance when 100mA current flows for 2 minutes.

(a) 100 J (b) 12 J

(c) 120 J (d) 1200 J

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Current (I) = 100mA

Resistance (R) = 10Ω

Time (t) = 2 min = 120 sec

Electrical energy (E) = I^2Rt

$= (100\times10^{-3})^2\times10\times120$

$= 12J$

11. In electromagnetic induction, the energy is supplied to the circuit and a part of this supplied energy is spent to meet.....

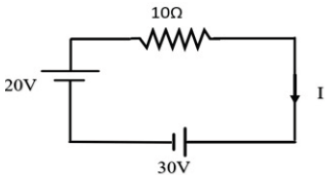
(a) I^2R losses (b) Hysteresis loss

(c) Eddy current loss (d) Iron losses

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : In electromagnetic induction, the energy is supplied to the circuit and a part of this supplied energy is spent to meet I^2R losses.

12. In the circuit shown below, the current I in the circuit is:

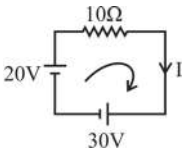


(a) 0 A (b) 1 A

(c) 2 A (d) –1 A

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) :



Applying KVL in loop-

$20-10I-30 = 0$

$\boxed{I = -1A}$

13. A heater of resistance 300Ω is connected to the main supply for 10 minutes. If the heat produced in the heater during this time is 18 J, then find the current through it.

(a) 10A (b) 100A

(c) 0.10A (d) 0.01A

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Given:

R = 300Ω, t = 10 minutes = 600 second

Heat (H) = 18 joule, I =?

We know that,

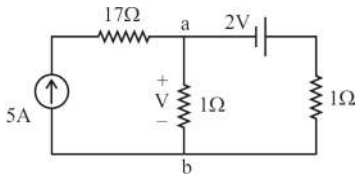
$H = I^2Rt$

$18 = I^2 \times 300 \times 600$

$I^2 = 1\times10^{-4}$

$\Rightarrow$ $\boxed{I = 0.01A}$

14. Find the value of V in the circuit shown below.

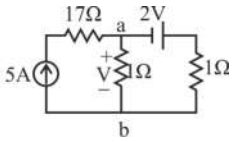


(a) 3V (b) –1.5V

(c) 1.5V (d) 0V

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) :



Apply KCL at node 'a'

$$\frac{V}{1}+\frac{V+2}{1}=5$$

$2V + 2 = 5$

$2V = 3$

$\boxed{V = 1.5 \text{ Volt}}$

15. In case of heating effect, if 1 calorie of heat energy is converted into joules, then its value will be _____.

(a) 3.743 joules (b) 2.563 joules

(c) 4.186 joules (d) 1.853 joules

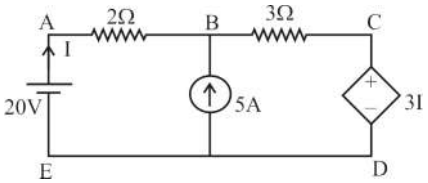
SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : We know that,

1 calorie = 4.184 joules.

Heat capacity is determined by both the type and amount of substance that absorbs or releases heat.

16. In the circuit shown below, the value of the current I is:

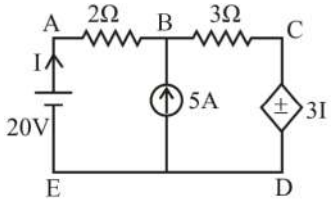


(a) 1A (b) 0A

(c) $\frac{5}{8}$A (d) $-\frac{5}{8}$A

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) :



Applying KCL at node B

$$\frac{V-20}{2}+\frac{V-3I}{3}=5$$

$3V-60+2V-6I=30$

$5V-6I=90$ ….(i)

From the above given circuit -

$$I=\frac{20-V}{2} \quad \text{…(ii)}$$

$$5V-\frac{6(20-V)}{2}=90$$

$5V-60+3V=90$

$8V=150$

$$V=\frac{150}{8}=\frac{75}{4}$$

$$I=\frac{20-\frac{75}{4}}{2}$$

$$I=\frac{80-75}{8}$$

$$\boxed{I=\frac{5}{8}}$$

17. A wire of resistance 88 Ω is stretched to twice its original length. The resistance of a stretched wire would be _____.

(a) 176Ω (b) 352Ω

(c) 88Ω (d) 22Ω

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,

R = 88Ω and length is twice its original length

$$\boxed{R=\frac{\rho\ell}{a}}$$

$V_1 = V_2$

$a_1(\ell) = a_2(2\ell)$

$$a_2=\frac{a_1\ell}{2\ell}$$

$$\boxed{a_2=a_1/2}$$

$$R_1=\frac{\rho\times 2\ell}{a_1/2}$$

$$R_1=\frac{4\rho\ell}{a_1}=4R$$

$R_1 = 4\times 88$

$$\boxed{R_1=352\Omega}$$

18. A 400 W,100 V bulb is connected across a 50 V source. The current drawn by the bulb is

(a) 4 A (b) 2 A

(c) 1 A (d) 0 A

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,

P = 400 W,

V = 100V, V' = 50V

$$\boxed{P=\frac{V^2}{R}}$$

$$P'=\left(\frac{V'}{V}\right)^2\times P$$

$$P'=\left(\frac{50}{100}\right)^2\times 400$$

$$P'=\left(\frac{1}{2}\right)^2\times 400$$

$$\boxed{P'=100\,\text{Watt}}$$

$P' = V'I$

$100 = 50\times I$

$$\boxed{I=2\,\text{Amp}}$$

19. Calculate the resistance per metre length of a wire of diameter 40 mm and specific resistance of 3.14×10^{-4} Ω-m:

(a) 4 Ω (b) $\frac{1}{4}\Omega$

(c) 40Ω (d) 400Ω

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,

D = 40mm

$r = D/2 = \frac{40}{2} = 20mm$

Specific resistance (ρ) = $3.14\times10^{-4}\Omega$–m

We know that,

$$R = \frac{\rho\ell}{A}, A = \pi r^2$$

$$R = \frac{\rho\ell}{A}$$

$$\frac{R}{\ell} = \frac{3.14\times10^{-4}}{3.14\times\left(20\times10^{-3}\right)^2} = \frac{3.14\times10^{-4}}{3.14\times400\times10^{-6}}$$

$$\frac{R}{\ell} = \frac{100}{400} = \frac{1}{4}$$

From the given option taking ℓ = unity

Then,

$$\boxed{R = \frac{1}{4}\Omega}$$

20. The dual pair of the node and open circuit are–

(a) KVL and short circuit

(b) Mesh and open circuit

(c) Mesh and short circuit

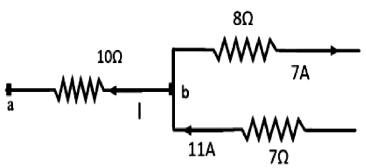
(d) Mesh and KCL

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : The dual pair of the node and open circuit are mesh and short circuit respectively.

Electric circuit	Magnetic circuit
Current	Flux
Resistance	Reluctance
emf	mmf
Conductance	Permeance

21. The value of voltage V_{ab} in the figure shown below is :

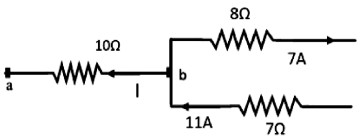


(a) 0 V (b) – 40 V

(c) 40 V (d) –190 V

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :



KCL at node (b) -

I+7–11= 0

$$\boxed{I = 4A}$$

Then,

$V_{ba} = I\times 10$

$= 4\times10$

$V_{ba} = 40$

$$\boxed{V_{ab} = -40\,V} \qquad \because V_{ba} = -V_{ab}$$

22. The value of a series resistor is required to limit the current through an LED to 36mA with a forward voltage drop of 3V, when connected to a 12V supply.

(a) 250 m Ω (b) 25 Ω

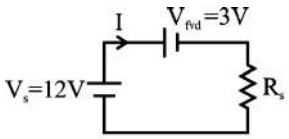
(c) 4000 Ω (d) 250 Ω

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given,

I= 36mA, V_{fvd} = 3V, V_s = 12 V

Then, $I = \frac{V_s - V_{fvd}}{R_s}$



$36\ mA = \frac{12-3}{R_s}$

$R_s = \frac{9\times1000}{36}$

$$\boxed{R_s = 250\Omega}$$

23. A coil consists of 1000 turns having a cross-sectional area of 0.4 mm^2. The mean length per turn is 40 cm and the resistivity of the wire is 0.02μΩ–m. The resistance of the coil is _____.

(a) 400Ω (b) 20μΩ

(c) 200Ω (d) 20Ω

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given,
Total length $\ell = 1000\times40$ cm$= 1000\times0.4$m $= 400$ m
$A = 0.4$ mm$^2 = 0.4\times(10^{-3})^2 = 0.4\times10^{-6}$m^2
$\rho = 0.02\mu\Omega$-m$= 0.02\times10^{-6}\Omega$-m
then,

$$R = \frac{\rho\ell}{A}$$

$$= \frac{0.02\times10^{-6}\times400}{0.4\times10^{-6}} = 20\Omega$$

24. A constant voltage source is applied between the two ends of a wire. If the length of the wire is doubled and the radius remains the same, then the rate of heat developed in the wire ____.

(a) will be 4 times (b) will be zero
(c) will be halved (d) will remain the same

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : We know that

$$H \propto \frac{1}{R} \qquad \left\{H = \frac{V^2}{R}t\right\}$$

From question

$$R_1 = \frac{\rho\ell}{A}$$

Again $R_2 = \frac{2\rho\ell}{A}$

then $H_1 \propto \frac{1}{R_1}$.....(i)

& $H_2 \propto \frac{1}{R_2}$.....(ii)

dividing (i) & (ii)

$$\frac{H_1}{H_2} = \frac{R_2}{R_1}$$

$$\frac{H_1}{H_2} = \frac{2\rho\ell}{A}\times\frac{A}{\rho\ell}$$

$$\therefore \quad \frac{H_1}{H_2} = \frac{2}{1}$$

$$\therefore \quad H_2 = \frac{1}{2}H_1$$

So heat developed will be halved.

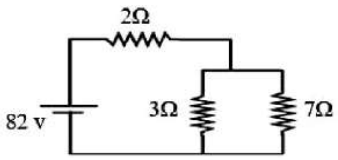
25. In case of circuit laws, the currents flowing in various conductors in an electrical circuit are calculated by applying _____.

(a) Laplace's law
(b) the network reduction method
(c) the direct method
(d) Kirchhoff's law

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : In case of circuit laws, the currents flowing in various conductors in an electrical circuit are calculated by applying Kirchhoff's law.
There are two laws of Kirchhoff-
(i) KCL (Kirchhoff 's current law)
(ii) KVL (Kirchhoff's voltage law)

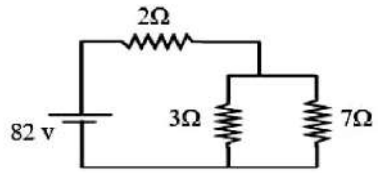
26. Find the current flowing through the 7Ω resistor.



(a) 20 A
(b) 6 A
(c) 7 A
(d) 14 A

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :



From figure

$$R_{eq} = 2+(3\,||\,7)$$

$$R_{eq} = 2+\frac{3\times7}{3+7} = 4.1\Omega$$

then $I = \frac{82}{4.1} = 20A$

then $I_{7\Omega} = \frac{20\times3}{10} = 6A$

27. An electric kettle consumes 10kW of electric power when operated at 200 V. A fuse wire of what rating must be used for it ?

(a) 10A (b) 50A
(c) 40A (d) 30A

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : As we know that fuse wire should pass the maximum current which an appliance requires.

$$P = VI$$

So from the given values.

$$I = \frac{P}{V} = \frac{10kW}{200V} = \frac{10\times1000}{200} = 50A$$

ii. Network Theorems

28. Reciprocity theorem CANNOT be applied to the circuit having.....

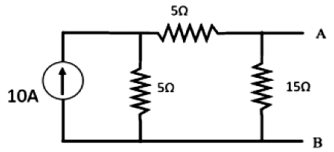
(a) Bilateral elements
(b) Non-linear elements and multi-sources
(c) Linear elements
(d) Only one independent source

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Reciprocity theorem cannot be applied to the circuit having non-linear element and multi sources.

Reciprocity theorem- In a linear bidirectional single source network the ratio of response to excitation remains the same even when the position of response and excitation are interchanged.

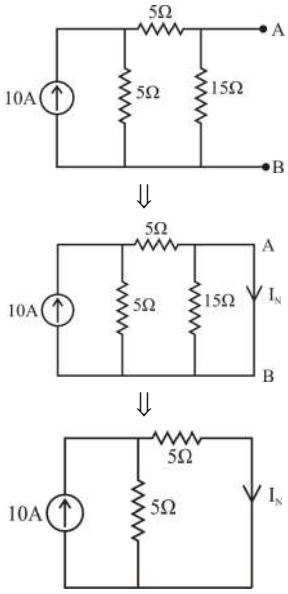
29. The Norton's equivalent current between the load terminal A-B will be:



(a) 0 A (b) 10 A
(c) 20 A (d) 5A

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) :



According to current division rule-

$$I_N = \frac{5}{5+5} \times 10 \qquad \left[I_2 = \frac{R_1}{R_1 + R_2} \times I \right]$$

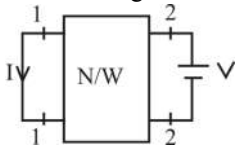
$$\boxed{I_N = 5A}$$

30. Which of the following is true regarding reciprocity theorem?

(a) The difference between response and excitation remains the same
(b) The product of response and excitation remains the same
(c) The sum of response and the excitation remains the same
(d) The ratio of the response to the excitation remains the same

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : If any linear passive, Bilateral network excited with only a single source, then the ratio of response to excitation remains constant if the position of source and load are interchanged.

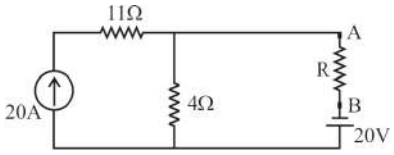


From reciprocity theorem = $\frac{\text{Response}}{\text{Excitation}} = \text{constant}$

$$\boxed{\frac{I_1}{V_1} = \frac{I_2}{V_2}}$$

- This theorem is not applicable when network consist dependents source.
- This theorem is valid for network with only single source.

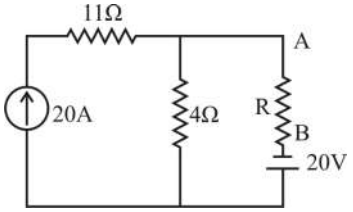
31. The Thevenin's equivalent voltage across terminal A-B shown in the figure is ———.



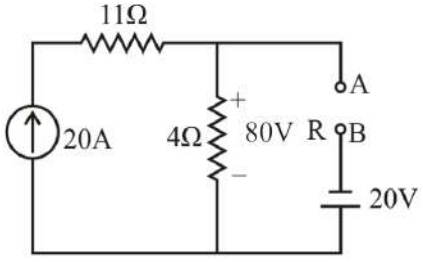
(a) 300 V (b) 10 V
(c) 80 V (d) 100 V

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Given that,



For V_{AB}



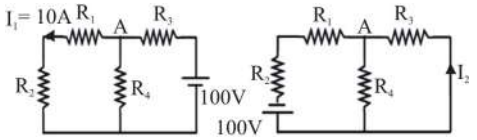
Apply KVL

$V_A - 80 - 20 - V_B = 0$

$V_A - V_B = 100$

$\boxed{V_{AB} = 100V}$

32. The value of the current I_2 if I_1 is equal to 10A, is:

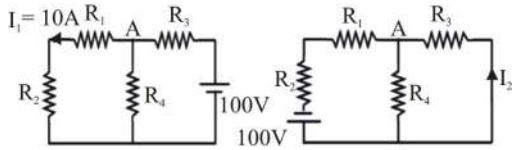


(a) $\frac{100}{R_3}A$ (b) 0 A

(c) $\frac{100}{R_2}A$ (d) 10 A

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given ,



According to reciprocity theorem-

The ratio between response and excitation remains the same even after the position of response and excitation are interchanged.

Then, $\boxed{I_2 = 10\,\text{Amp}}$

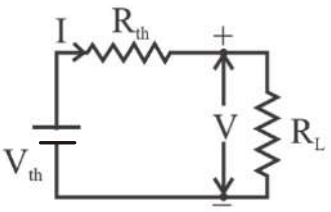
33. A voltage source having some internal resistance delivers a 2A current when a 5Ω load is connected to it. When the load is 10Ω, then the current becomes 1.6A. Calculate the power transfer efficiency of the source for a 15Ω load.

(a) 90% (b) 50%

(c) 100% (d) 10%

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given,



$V_{th} = IR_{th} + V$

$V_{th} = 2R_{th} + 10$ .....(i)

Again $V_{th} = 1.6R_{th} + 16$ .....(ii)

$0.4R_{th} = 6$ Subtracting (i) &(ii)

$R_{th} = \frac{6}{0.4} = \frac{60}{4} = 15\Omega$

Which shows $R_L = R_{th}$

∴ By maximum power transfer theorem power transfer efficiency is equal to 50%.

34. A 64kΩ resistor has a specified maximum power dissipation of 1000 watts. The maximum current that may be passed through the resistor is _____.

(a) 64A (b) 32A

(c) $\frac{1}{8}A$ (d) 8A

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : We know that,

$\boxed{P = I_{max}^2 R}$

According to question

Maximum current $I_{max} = \sqrt{\frac{P}{R}}$

$= \sqrt{\frac{1000}{64 \times 10^3}}$

$= \sqrt{\frac{1}{64}} = \frac{1}{8}A$

iii. Electrostatics and Capacitor

35. The ability of a capacitor to store charge does NOT depend on the .....

(a) Amount of charge

(b) Distance between the plates

(c) Areas of the plates

(d) Nature of the insulating material

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Capacitance $(C) = \frac{\varepsilon_0 \varepsilon_r A}{d}$

Capacitance depends -

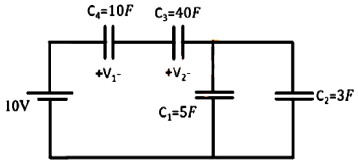
1. Distance between the plates

2. Area of the plates

3. Natures of the insulating material

The ability of a capacitor to store charge does not depend on the amount of charge.

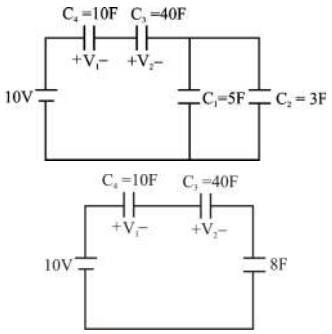
36. For the circuit shown below, the voltage across 10F and 40 F capacitors are:



(a) 4 V and 1V, respectively
(b) 1V and 4V, respectively
(c) 400 V and 1600 V, respectively
(d) 10 V and 40 V, respectively

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) :



Applying voltage division rule-

$$V_1 = \frac{\frac{1}{10}}{\frac{1}{10}+\frac{1}{40}+\frac{1}{8}} \times 10$$

$$= \frac{\frac{1}{10}}{\frac{4+1+5}{40}} \times 10 = \frac{40}{100} \times 10 = 4V$$

$$V_2 = \frac{\frac{1}{40}}{\frac{4+1+5}{40}} \times 10 = \frac{10}{10} = 1V$$

37. A capacitor that stores energy of 8 J and has capacitance of 1 F has a potential difference of _____ across it.

(a) 1V (b) 12V
(c) 4V (d) 2V

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Given that,

$W_c = 8J$

$C = 1F$

$$\boxed{W_c = \frac{1}{2}CV^2}$$

$$W_c = \frac{1}{2}CV^2$$

$$8 = \frac{1}{2} \times 1 \times V^2$$

$$V^2 = 16$$

$$\boxed{V = 4V}$$

38. What is the maximum electric field when V_{bi} =3 V, V_R=4V, and the width of the semiconductor is 7 cm?

(a) –400 V/m (b) –200 V/m
(c) 200 V/m (d) 300 V/m

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given,

$V_{max} = ?$

$V_{bi} = 3V$

$V_R = 4V$

$W = 7cm = 7 \times 10^{-2}m$

Then $V_{max} = \frac{-2(V_{bi}+V_R)}{W}$

$$V_{max} = \frac{-2(3+4)}{7\times10^{-2}} = -200\,V/m$$

39. The capacitance of a parallel plate capacitor having two plates of area A = 200 cm^2 and separated by distance d = 10 cm is given by _____ if the permittivity of medium is 8.854 $\times 10^{-12}$ F/m

(a) 17.7 μF (b) 17.7×10^{-7} μF
(c) 17.7 F (d) 17.7 PF

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given,

$A = 200\ cm^2 = 200 \times 10^{-4} m^2$

$d = 10\ cm = 10 \times 10^{-2} = 10^{-1} m$

$\varepsilon_0 = 8.854 \times 10^{-12}\,F/m$

$$\therefore \quad C = \frac{\varepsilon_0 A}{d}$$

$$= \frac{8.854\times10^{-12}\times200\times10^{-4}}{10^{-1}}$$

$= 1.7708 \times 10^{-12} F$

$= 1.77 \times 10^{-12} \times 10^6 \mu F$

$= 17.7 \times 10^{-7} \mu F$

iv. Electromagnetic Induction & Magnetism

40. Calculate the respective value of magnetising force and flux density at a distance of 10 cm from a long circular conductor carrying a current of 100π A, placed in air?

(a) 500 AT/m and $6.28\times10^{-4} Wb/m^2$
(b) 6.28×10^{-7} AT/m and 500 Wb/m^2
(c) 50 Wb/m^2 and 6.28×10^{-7} AT/m
(d) 1500 Wb/m^2 and 3.14×10^{-4} AT/m

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) :

$r = 10cm = 10\times10^{-2}m$

$I = 100\pi$ A

Magnetising force $(H) = \frac{NI}{2\pi r} = \frac{100\pi}{2\times\pi\times10\times10^{-2}}$

$= 500$ AT/m

Flux density $(B) = \mu H$

$= 4\pi\times10^{-7}\times500$

$= 6.28 \times 10^{-4}$ wb/m^2

41. In case of magnetic circuits, the force producing magnetic flux is called____

(a) Reluctance
(b) MMF
(c) Absolute permeability
(d) Relative permeability

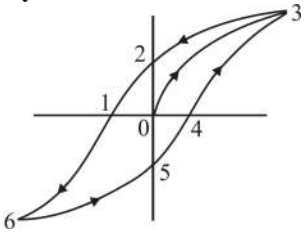
SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : In case of magnetic circuits, the force producing magnetic flux is called MMF.

$\boxed{MMF = NI = S\phi}$

N→ Number of turn
I→ Current
S →Reluctance
ϕ→ Flux

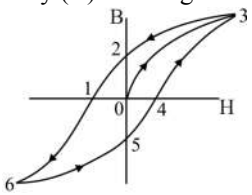
42. Which of the following portions represents retentivity in the BH curve shown below?



(a) 1 (b) 3
(c) 2 (d) 6

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : BH curve is the graph plotted between magnetic flux density (B) and magnetic force (H).



When H is decreased, B is not decreased in the same path but follows the other path as when H is zero, B is not Zero but has some finite value shown in figure (0 to 2) This is residual magnetism, the ability of retaining residual magnetism is known as retentivity of the material. Hence, portions 2, 5 represents retentivity in the BH curve shown in figure.

43. In case of magnetic circuits, the flux produced per unit area of the magnetic material, for every unit of the magnetising force applied to it, is called _____.

(a) Absolute permeability
(b) EMF
(c) MMF
(d) Relative permeability

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : In case of magnetic circuits, the flux produced per unit area of the magnetic material, for every unit of the magnetizing force applied to it is called absolute permeability.

$\boxed{\mu = \mu_0\mu_r}$

Where,

$\mu_0 = 4\pi\times10^{-7}$H/m → absolute permeability of air

μ_r= relative permeability of the material.

44. Which law gives the direction of induced EMF?

(a) Maxwell's law (b) Gauss's law
(c) Lenz's law (d) Newton's law

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Lenz's law gives the direction of induced emf. Lenz's law gives an easy way to determine the sign of the induced emf and determine direction of induced emf.

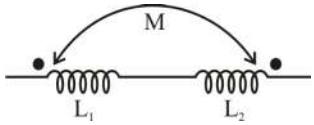
Lenz's law states, "the magnetic field produced by an induced current always opposes any change in the magnetic flux.

45. In the context of electromagnetic induction, if the magnetic fluxes of two coils oppose each other, then the connection is called.....

(a) Self-opposing (b) Parallel opposing
(c) Series opposing (d) mutually opposing

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : In the context of electromagnetic induction, if magnetic fluxes of two coils oppose each other, then the connection is called series opposing.



$L_{eq} = L_1+L_2 -2M$

$M = K\sqrt{L_1L_2}$

K→ Coupling factor

L_1, L_2→ Self inductance

M→ Mutual inductance

46. Which of the following types of fields is used as a coupling medium in all electromechanical conversion devices?

(a) Magnetic field only
(b) Electric field only
(c) Thermal field only
(d) Both electric field and magnetic field

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : The magnetic field is used as the coupling medium in all electromechanical conversion devices because the energy storing capacity of the magnetic field is much higher than the electric field.

47. The property where magnetic field of one of the coils makes the other coil to induce an EMF in it is called _____.

(a) Self-inductance (b) Mutual inductance
(c) Resistance (d) Capacitance

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : The property where magnetic field of one of the coils makes the other coil to induce an EMF in it is called mutual inductance.

• When two coils of the number of turns N_1 and N_2 are placed closed to each other. Then the mutual inductance of coil 1 with respect to coil 2 is given as-

$$M_{12} = \frac{N_1\phi_1}{I_2} \text{ Henry}$$

Where,

N_1 = Number of turns in coil 1

ϕ_1 = Flux linked with coil 1

I_2 = Current in coil 2

48. In case of magnetic circuits, the ratio of the flux density developed in the magnetic material to the flux density developed in air, for the same amount of magnetising force applied to it, is called _____.

(a) Relative permeability
(b) EMF
(c) Absolute permeability
(d) Reluctance

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : In case of magnetic circuits, the ratio of the flux density developed in the magnetic material to the flux density developed in the air, for the same amount of magnetizing force applied to it, is called relative permeability.

$$\mu_r = \frac{B}{B_0} = \frac{B(\text{material})}{B_0(\text{Vacuum})}$$

49. Self-inductance does NOT depend on which of the following parameters?

(a) Flux
(b) Number of turns
(c) Current flowing through the conductor
(d) Length of the conductor

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Self-inductance (L) is given as:

$$L = \frac{N\phi}{I}$$

Where,

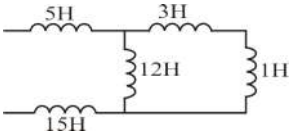
ϕ = Flux

N = Number of turns

I = Current flowing through the conductor

hence, self-inductance does not depend on the length of the conductor.

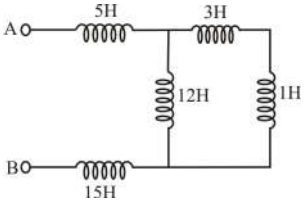
50. Find the value of equivalent inductance across terminal AB in the following circuit.



(a) 23H (b) 50H
(c) 26H (d) 36H

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Given,



Equivalent inductance across terminal AB is-

L_{eq}= [{(3+1)||12 }+ (5 +15)]

L_{eq} = [{4||12} +20]

$$L_{eq} = 23H$$

51. If the energy stored in a 5H inductor is 160 joules, then calculate the current passing through it.

(a) 8A (b) 10A
(c) 64A (d) 18A

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Given,

L = 5H, E = 160 joules

I = ?

Energy stored in inductor is given by,

$$E = \frac{1}{2}LI^2$$

$$160 = \frac{1}{2}\times 5 \times I^2$$

$\Rightarrow$ $I^2 = 64$

$\Rightarrow$ $I = 8Amp$

52. In electromagnetic induction, according to Fleming's right-hand rule, the forefinger represents _____.

(a) Direction of the motion of the conductor
(b) Direction of the magnetic field
(c) Direction of the induced EMF
(d) Direction of the induced current

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : In electromagnetic induction according to Fleming's right-hand rule, the fore-finger represents direction of magnetic field, the thumb represents the direction of the motion of the conductor, and the middle finger represents the direction of the induced currents.

53. In electromagnetic induction, Lenz's law directly follows _____.

(a) The law of conservation of energy
(b) Faraday's second low
(c) Laplace's law
(d) Faraday's first law

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : In electromagnetic induction, Lenz's law directly follows the law of conservation of energy.

• This law states that the induced current always tends to oppose the cause which produces it.

54. In a series connection of inductances, L_1 and L_2 are inductances and M is the mutual inductance. Find the total inductance.

(a) $L_1 + L_2 - 2M$ (b) $L_1 + L_2 + 2M$
(c) $L_1 + L_2 - M$ (d) $L_1 + L_2 + M$

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,
Self inductances L_1, L_2
In series connection if mutual inductances M(+Ve)-
Total inductance $\boxed{L_{eq} = L_1 + L_2 + 2M}$
In series connection if mutual inductance M(–Ve)-
Total inductance $\boxed{L_{eq} = L_1 + L_2 - 2M}$

55. In Electromagnetism, the field pattern of a magnetic field inside the toroid is _____.

(a) Uniform (b) Hyperbolic
(c) Parabolic (d) Non-uniform

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : In electromagnetism, the field pattern of a magnetic field inside the toroid is non-uniform. A toroid can be considered as a circular solenoid that is used in electric circuit.

$$\boxed{B = \frac{\mu_0 NI}{2\pi r}}$$

56. In electromagnetism, the pattern of the magnetic field in a solenoid is ____.

(a) of curved lines
(b) circular
(c) of parallel straight lines
(d) of perpendicular lines

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The magnetic field lines inside a current carrying solenoid are in the form of parallel straight lines. This pattern of field line is indicating that the strength of the magnetic field is the same at all the points inside the current carrying solenoid. That is, the field is uniform inside the current - carrying solenoid.

57. If 15A current is flowing through a solenoid of inductance 4H, find the magnetic energy stored in the solenoid.

(a) 450 J (b) 540 J
(c) 100 J (d) 1000 J

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Given,
I= 15 A, L= 4H
then,
Energy stored in the solenoid-

$$E = \frac{1}{2}LI^2$$

$$= \frac{1}{2} \times 4 \times (15)^2 = \frac{1}{2} \times 4 \times 225$$

$$\boxed{E = 450 \text{ Joule}}$$

58. In case of electromagnetic induction, two coils are arranged in such a way that a change in one coil causes an EMF to be induced in the other coil. This is called _____.

(a) self-inductance (b) parallel inductance
(c) series inductance (d) mutual inductance

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : When two coils are arranged in such a way that a change of current in one coil causes an emf to be induced in the other coil, then this phenomenon is called mutual inductance, it is denoted by (M).

$$M = \frac{N_2 \phi_1}{I_1}$$

59. The total inductance of two coupled coils in the 'series aiding' and 'series opposing' connections are 4 H and 2 H, respectively. The value of mutual inductance will be _____.

(a) 0.2 H (b) 0.5 H
(c) 0.33 H (d) 0.75 H

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given,

$L_{eq} = 4H \rightarrow$ for series aiding

$L_{eq} = 2H \rightarrow$ For series opposing

then,

$L_{eq} = L_1 + L_2 + 2M$ ..... (i)

and $L_{eq} = L_1 + L_2 - 2M$ ..... (ii)

Putting values and subtracting (i) & (ii)

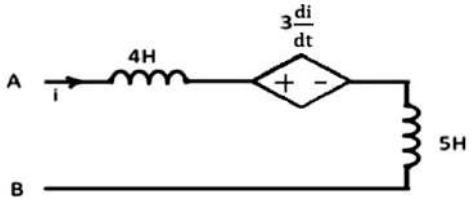
$4 = L_1 + L_2 + 2M$

$2 = L_1 + L_2 - 2M$

$2 = 4M$

$\therefore \quad M = \frac{1}{2} = 0.5\,H$

60. Find the value of the equivalent inductance as seen from the open terminal for the diagram shown below.

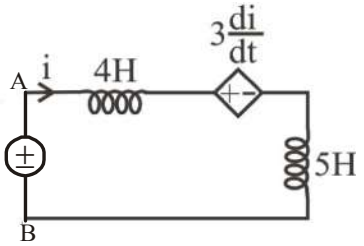


(a) 12H (b) 24H

(c) 10H (d) 9H

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Given,



Apply KVL in the circuit-

$$V = 4\frac{di}{dt} + 3\frac{di}{dt} + 5\frac{di}{dt}$$

$$V = 12\frac{di}{dt}$$

$$V = L\frac{di}{dt}$$

$\therefore \quad L_{eq} = 12H$

61. What inductance would be needed to store 2kWh of energy in a coil carrying a 100 A current ?

(a) 4 H (b) 1440 H

(c) 0.4 H (d) 100 H

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : W= 2kWh= $2\times3.6\times10^6$ Joule

$\therefore \quad W = \frac{1}{2}LI^2$

$$2\times3.6\times10^6 = \frac{1}{2}\times L\times100\times100$$

$$7.2\times10^2 = \frac{1}{2}\times L$$

$\therefore \quad L = 1440\ H$

v. AC Circuit, Resonance, Steady State and Transient State Analysis

62. The admittance of an electric is represented by Y = (3+j4). What is the value of resistance in this circuit?

(a) $\frac{2}{25}\Omega$ (b) $\frac{3}{25}\Omega$

(c) $\frac{1}{25}\Omega$ (d) $\frac{4}{25}\Omega$

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Admittance (Y) = 3+j4

$$\text{Impedance } (Z) = \frac{1}{Y} = \frac{1}{3+j4}\times\frac{3-j4}{3-j4}$$

$$= \frac{3-j4}{9+16} = \frac{3}{25} - \frac{j4}{25}$$

Compare- Z = R -jX

$$\boxed{R = \frac{3}{25}\Omega}$$

63. For an AC circuit, the voltage and the current are given as V = (100 +j10) V and I = (20 –j10) A, respectively. The active power of the circuit is:

(a) P = 1900 W (b) P = 1500 W

(c) P = 1800 W (d) P = 1000 W

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Given,

V = (100+j10)V

I = (20 -j10)A

Apparent power (S) = VI* =

= (100 + j10) (20 + j10)

= 2000 –100 + j (1000 + 200)

= 1900 + j 1200 = P +jQ

Active power (P) = 1900 watt

64. A voltage of $230\angle 60^\circ$ is applied to a current offering an impedance of 10 + j10 Ω. Find the expression for the current flowing through the circuit in polar form.

(a) $23\angle 45^\circ$ leading (b) $16.3\angle 15^\circ$ lagging

(c) $23\angle 45^\circ$ lagging (d) $16.3\angle 15^\circ$ leading

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given,

$V = 230\angle 60^\circ$

$Z = 10 + j10 = 10\sqrt{2}\angle 45^\circ$

$Z = \sqrt{(10)^2 + (10)^2} = 10\sqrt{2}$

$\cos\phi = \frac{R}{Z} = \frac{10}{10\sqrt{2}}$

$\phi = 45^\circ$

$Z = 10\sqrt{2}\angle 45^\circ$

$I = \frac{V}{Z} = \frac{230\angle 60^\circ}{10\sqrt{2}\angle 45^\circ}$

$= 16.3\angle 15^\circ$ (Leading)

65. In an electrical signal waveform, if each value on the curve is proportional to sine of the angle of rotation of the coil, then such a wave is called.....

(a) Ramp wave (b) Square wave

(c) Triangular wave (d) Sine wave

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : In an electrical signal waveform, if each value on the curve is proportional to sine of angle or rotations of the coil, then such a wave is called sine wave.

66. Calculate the apparent power of a circuit if the circuit has a power factor of 0.8 and the active power of the circuit is 40 W.

(a) 100 VA (b) 40 VA

(c) 75 VA (d) 50 VA

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Power factor = 0.8

Active power (P) = 40W

Active power = Apparent power × power factor

40 = Apparent power × 0.8

Apparent power = 50 VA

67. In an electrical circuit, the current that changes periodically, both in magnitude and direction, at regular intervals of time is called.....

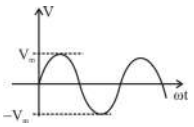
(a) Direct current (b) Phase current

(c) Leading current (d) Alternating current

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : In electrical circuit, the current that changes periodically both in magnitude and direction at regular intervals of time is called alternating current.

$\boxed{V = V_m \sin\omega t}$



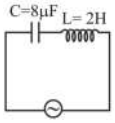
68. An LC circuit with inductance L=2H and capacitance C = 8 μF is connected to an AC source. Find the value of the power factor of combination.

(a) 10 (b) 0

(c) 8 (d) 2

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :



R = 0

Power factor ($\cos\phi$) = $\frac{R}{Z}$

= $\boxed{\cos\phi = 0}$

69. In a pure inductive circuit, if the frequency of the AC source is doubled, then its inductive reactance will:

(a) Become zero (b) Be halved

(c) Remain the same (d) Be doubled

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Inductive reactance (X_L) = $2\pi fL$

$\boxed{X_L \propto f}$

if the frequency of AC source is doubled then its inductive reactance will be doubled.

70. The expression for the RMS value of the current of a triangular wave form is:

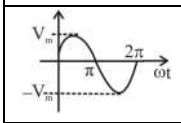
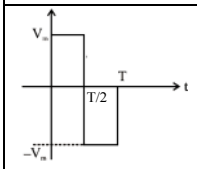
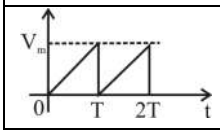
(a) $\frac{I_{max}}{\sqrt{2}}$ (b) $\frac{I_{max}}{2}$

(c) $\sqrt{3}I_{max}$ (d) $\frac{I_{max}}{\sqrt{3}}$

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : The expression for the RMS value of the current of a triangular waveform is:

$\boxed{I_{rms} = \frac{I_m}{\sqrt{3}}}$ $\boxed{I_{avg} = \frac{I_m}{2}}$

Waveform	RMS value	Average values
	$\frac{V_m}{\sqrt{2}}$	$\frac{2V_m}{\pi}$
	V_m	V_m
	$\frac{V_m}{\sqrt{3}}$	$\frac{V_m}{2}$

71. What will be the phase difference between the alternating current and the voltage represented by the following.

Equation $I= I_0 \sin(\omega t)$ and $E= E_0\cos(\omega t+\pi/3)$?

(a) $\frac{4\pi}{3}$ (b) $\frac{5\pi}{6}$

(c) $\frac{\pi}{3}$ (d) $\frac{5\pi}{3}$

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given,

$I = I_0 \sin(\omega t)$

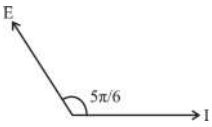
$E = E_0\cos(\omega t +\pi/3)$

$\phi = ?$

$E = E_0 \sin(\omega t +\pi/3 + \pi/2)$ $[\because \sin(90^\circ+\theta) = \cos\theta]$

$$E = E_0\sin\left(\omega t + \frac{5\pi}{6}\right)$$

$I = I_0\sin(\omega t)$



$$\boxed{\phi = \frac{5\pi}{6}}$$

So, phase difference between the alternating current and voltage is equal to $\frac{5\pi}{6}$.

72. A series RLC circuit has the following parameter values: R = 5Ω, L = 0.01 H, C = 100 μF, voltage source (t) = 10 sin 1000t. What is the value of quality factor?

(a) 2 (b) 1

(c) 2.51 (d) 1.11

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Given,

$R = 5\Omega,\ L = 0.01H$

$C = 100\mu F$

Quality factor (Q) = $\frac{1}{R}\sqrt{\frac{L}{C}}$

$$Q = \frac{1}{5}\times\sqrt{\frac{0.01}{100\times10^{-6}}}$$

$$Q = \frac{1}{5}\times10 = 2$$

$$\boxed{Q = 2}$$

73. An RLC series circuit has resonance frequency of 170 kHz and quality factor of 25. Find the bandwidth of the circuit.

(a) 6.8 kHz (b) 50 Hz

(c) 68 kHz (d) 13.6 kHz

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Given,

$Q = 25,\quad f_0 = 170kHz$

B.W = ?

We known that-

$$B.W = \frac{\text{Resonance frequency}}{\text{Quality factor}} = \frac{f_0}{Q}$$

$$B.W = \frac{170}{25} = 6.8$$

$$\boxed{B.W = 6.8\ kHz}$$

74. The instantaneous current in a circuit is given by $i = 4\cos(\omega t + \theta)$ A. The RMS value of the current is:

(a) $4\sqrt{2}$ A (b) $3\sqrt{3}$ A

(c) $2\sqrt{2}$ A (d) Zero

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Given that,

$I = 4\cos(\omega t + \phi)$ Amp

Comparing with-

$I = I_m\cos(\omega t + \phi)$

$I_m = 4$

$$I_{rms} = \frac{I_m}{\sqrt{2}}$$

$$I_{rms} = \frac{4}{\sqrt{2}} = 2\sqrt{2}A$$

75. If the peak value of an alternating current is 8 A, then the RMS value of the current will be _____.

(a) $4\sqrt{2}$ A (b) $\sqrt{3}$ A

(c) $2\sqrt{3}$ A (d) $3\sqrt{2}$ A

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Given that;

$I_m = 8A$

$$\boxed{I_{rms} = \frac{I_m}{\sqrt{2}}}$$

$$I_{rms} = \boxed{\frac{8}{\sqrt{2}} = 4\sqrt{2}A}$$

76. A non-inductive resistor of 50 Ω is connected in series with a coil of inductance 0.25 Henry and of negligible resistance across a 250 V, 50 Hz supply. The net impedance of the circuit is given by 93.07 Ω. Find the value of reactive power.

(a) 1091.25 VAR (b) 567.59 VAR

(c) 1022.14 VAR (d) 727.5 VAR

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

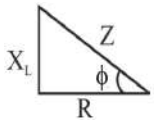
Ans. (b) : Given,

V= 250 V, f= 50Hz, R = 50Ω, L= 0.25H, Z= 93.07Ω

We know that,

Reactive power (Q) = VI sinϕ

$$\Rightarrow \sin\phi = \frac{X_L}{Z} = \frac{\omega L}{Z}$$



$$= \frac{2\pi f L}{Z} = \frac{2\times\pi\times 50\times 0.25}{93.07}$$

$$\cong 0.843$$

Then, $Q = VI\sin\phi$

$$= V\frac{V}{Z}\sin\phi = 250\times\frac{250}{93.07}\times 0.843$$

$$\boxed{Q \approx 567.59 \text{ VAR}}$$

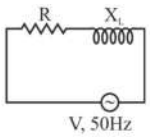
77. A resistor of resistance R is connected in series with a coil having an inductance of L henry. If X_L is the value of inductive reactance, what is the value of net impedance of the circuit ?

(a) $\frac{\sqrt{R}}{X_L}$ (b) $\sqrt{R^2 - X_L^2}$

(c) $\sqrt{R^2 + X_L^2}$ (d) $\frac{\sqrt{X_L}}{R}$

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) :



$Z = R + jX_L$

Then, $\boxed{(Z) = \sqrt{R^2 + X_L^2}}$

78. An AC circuit contains a resistance and inductance connected in series. The active power consumed by the circuit is equal to 4800 W and reactive power is 6400 VAR. Calculate the apparent power.

(a) 4233 VA (b) 8000 VA

(c) 1058.3 VA (d) 11200 VA

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given,

P= 4800 W, Q= 6400 VAR

We know that,

Apparent Power (S) = $\sqrt{P^2 + Q^2}$

$$= \sqrt{(4800)^2 + (6400)^2}$$

$$\boxed{S = 8000 \text{ VA}}$$

79. An RLC series circuit has R = 5 Ω and L = 1 H. Which of the following values of capacitance will make this circuit critically damped ?

(a) 0.20 F (b) 0.16 F

(c) 0.08 F (d) 0.30 F

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given that,

R= 5Ω, L= 1H

∵ For critically damped circuit.

$$R^2 = \frac{4L}{C}$$

$$\therefore \quad C = \frac{4\times 1}{25} = 0.16 \text{ F}$$

80. A coil having a resistance of 8 Ω and an inductance of 0.01911 Henry is connected across a 230 V, 50 Hz AC supply. The reactive power is equal to _____.

(a) 4.496 KVAR (b) 4.232 KVAR

(c) 3.703 KVAR (d) 3.174 KVAR

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given,

R= 8Ω, L= 0. 01911H

f = 50 Hz, V= 230 V

then, $X_L = 2\pi fL = 2\times\pi\times 50\times 0.01911$

$$= 6.00\Omega$$

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{64 + 36} = 10\Omega$$

$$\therefore \quad I = \frac{230}{10} = 23A$$

$$\text{and } \phi = \tan^{-1}\left(\frac{6}{8}\right) = 36.86^0$$

$$\therefore \quad \sin\phi = 0.6$$

Now, Reactive power = VI sinϕ

$$= 230\times 23\times 0.6$$

$$= 3174 \text{ VAR}$$

$$= 3.174 \text{ KVAR}$$

vi.Poly phase System

81. A balanced star connected load of 4+j3 Ω per phase connected to a 3-phase, 230 V (phase value) supply. Find the value of active power.

(a) 22.45 kW (b) 25.4 kW
(c) 19.13 kW (d) 15.34 kW

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Given,

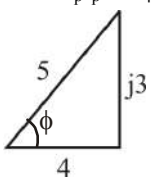
$Z_{ph} = 4+j3$

$|Z_{ph}| = \sqrt{4^2+3^2} = 5\Omega$

$V_{ph} = 230V$

$I_{ph} = \frac{V_{ph}}{|Z|} = \frac{230}{5} = 46$

$P = 3V_pI_p\cos\phi$



$= 3\times230\times46\times\frac{4}{5}$

$= 25.4kW$

82. Which of the following statements in NOT correct about active power in an AC circuit?

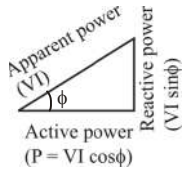
(a) Active power can be measured in terms of kilo watt
(b) Active power is the power dissipated in the pure inductance
(c) Active power is the power dissipated in the pure resistance
(d) Active power depend on power factor

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Correct statement for active power in an AC circuit-

(i) Active power can be measure in term of kilowatt.
(ii) Active power is the power dissipated in the pure resistance.
(iii) Active power depend on power factor.

$$\text{Power factor } (\cos\phi) = \frac{\text{Active power}}{\text{Apparent power}}$$



83. The voltage across the impedance 'Z' is 100∠15° V and the current through 'Z' is 20∠-45° A. Find the reactive power (Q).

(a) Q = 1000 VAR (b) Q = 1732 VAR
(c) Q = 600 VAR (d) Q = 6000 VAR

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Ans. (b) : Given,

$V = 100\angle 15^\circ$ V

$I = 20\angle -45^\circ$ A

Reactive power (Q) = ?

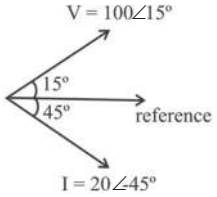
We know that,

$Q = V_{rms}.I_{rms}\sin\phi$

$Q = 100\times20\sin60^\circ$

$Q = 2000\times\frac{\sqrt{3}}{2} = 1732$

$\boxed{Q = 1732\,VAR}$



$\phi = 15^\circ+45^\circ$
$= 60^\circ$

84. Three phases (R,Y and B) of a balanced AC circuit with the phase sequence RYB are connected in star. These three voltages are equal in magnitude and displaced from one another by ———electrical angle.

(a) 360° (b) 90°
(c) 240° (d) 120°

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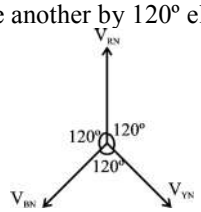
Ans. (d) : Three phase (R,Y and B) of a balanced AC circuit with the phase sequence RYB are connected in star. These three voltages are equal in magnitude and displaced from one another by 120° electrical angle.



85. In a three-phase balanced star connected system, which of the following will hold true [ϕ is the angle between phase voltage and phase current.]

(a) The angle between line currents and the corresponding line voltages are in phase.
(b) The angle between line currents and the corresponding line voltages is 30°+ϕ for lagging.
(c) The angle between line currents and the corresponding line voltages is 30°+ϕ for leading.
(d) The angle between line currents and the corresponding line voltages is 30°-ϕ for lagging.

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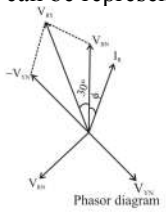
Ans. (b) : For a balanced three-phase star connected system, the voltage can be represented as-



$V_{RN} = V\angle\ 0^\circ$
$V_{YN} = V\ \angle -120^\circ$
$V_{BN} = V\angle -240^\circ$ or $V\angle 120^\circ$

From above phasor diagram, the angle between line current and the corresponding line voltages is 30+ϕ for lagging.

86. What is the apparent power of a 3-phase, star-connected system with a line voltage of 200 V and a line current of 20 A? The phase difference between the voltage and the current is 36.87°.

(a) 5.928 kVA (b) 8.928 kVA
(c) 6.928 kVA (d) 7.928 kVA

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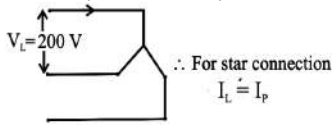
Ans. (c) : Given, $V_L = 200V$, $I_L = 20A$

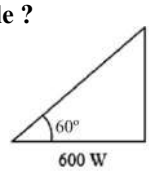


Then, Apparent Power (S) = $\sqrt{3}\ V_L I_L$

$= \sqrt{3} \times (200) \times (20)$

$S = 6.928$ kVA

87. What will be the reactive power in the given power triangle ?



(a) 1039 VAR Lagging (b) 1200 VAR Lagging
(c) 1039 VAR Leading (d) 1200 VAR Leading

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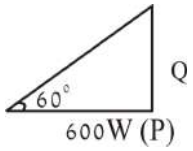
Ans. (a) : Given,

$\theta = 60^0$



We know that,

Reactive Power (Q) = P tan ϕ

$= 600 \times \sqrt{3} \quad \because \tan 60^0 = \sqrt{3}$

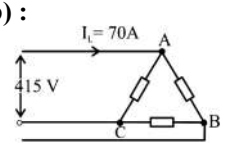
$Q = 1039.2$ VAR lagging

88. Three identical coils connected in delta to a 415 V, 3-phase supply take a total power of 50 kW and line currents of 70 A. Determine the total kVA taken by the coils.

(a) 16.77 kVA (b) 50.32 kVA
(c) 23.24 kVA (d) 9.68 kVA

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :



Given,

$V_L = 415$ V, $I_L = 70$A

Then,

total kVA (S) = $\sqrt{3}\ V_L I_L$

$= \sqrt{3} \times 415 \times 70$

$S = 50.3146$ kVA

89. When two or more sinusoidal waves are precisely in step with one another, they are said to be:

(a) out of phase
(b) 60 degrees lagging
(c) 60 degrees leading
(d) in phase

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : When two or more sinusoidal waves are precisely in step with one another, they are said to be in phase. Because step signal does not shift the signal in any direction.

90. A 230 V, 3-phase voltage is applied to a balance delta connected 3-phase load of phase impedance (15+j20)Ω. What is the power consumed per phase?

(a) 1269.6 W
(b) 2198.3 W
(c) 1161.6 W
(d) 3807.6 W

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Given that,

V= 230 V

for delta $V_L = V_{ph} = 230V$

$Z = 15 + j\ 20 = 25\angle 53.13$

$\phi = \angle 53.13$

Power factor = cos ϕ = 0.6

For delta $I_L = \sqrt{3}\, I_{ph}$

$$I_{ph} = \frac{V_{ph}}{Z} = \frac{230}{25} = 9.2A$$

So Power consumed per phase = $V_{ph}\, I_{ph} \cos\phi$

$= 230 \times 9.2 \times 0.6$

$= 1269.6$ W

91. In an AC circuit, the peak voltage is 388 V. Its effective voltage is :

(a) 200 V
(b) 300 V
(c) 275 V
(d) 230 V

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Given,

$V_m = 388V$

Then effective voltage

$$V_{eff} = V_{rms} = \frac{V_m}{\sqrt{2}}$$

$$V_{eff} = \frac{388}{\sqrt{2}} = 274.35$$

$\approx$ 275V

Chapter-2 Electrical Machine-I

i. General Concepts of Rotating Electrical Machine

1. Which of the following is the correct expression for eddy current (W_e) loss if B_{max} = Maximum flux density, f = Frequency of magnetic reversal, t = Thickness of each lamination and V = Volume of the armature core?

(a) $W_e = kB_{Max}^2 f^2 tV^2$ watts

(b) $W_e = kB_{Max}^2 ft^2 V^2$ watts

(c) $W_e = kB_{Max}^2 f^2 t^2 V^2$ watts

(d) $W_e = kB_{Max}^2 f^2 t^2 V$ watts

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Eddy current loss (W_e) = $KB_{max}^2 f^2 t^2 V$ Watt

$B_{max}\rightarrow$ Maximum flux density (Wb/m^2)

$f \rightarrow$ Frequency of magnetic reversal

$t \rightarrow$ Thickness of each lamination

$v\rightarrow$ Volume of the armature core (m^3)

Hysteresis loss (W_h) = $\eta B_{max}^{1.6} fV$ Watt

η = Steinmetz's constant

$B_{max}\rightarrow$ Maximum flux density

$f \rightarrow$ Supply frequency

ii. DC Motor

2. Why is the hold-on coil connected in series with the shunt field in a three-point starter of a DC motor?

(a) To prevent the motor from running away in case of an open-field circuit

(b) To provide the lubricant for the motor

(c) To disconnect the supply when the motor is in normal operation

(d) To control the speed of the motor

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : The hold on coil connected in series with the shunt field in a three-point starter of a DC motor to prevent the motor from running away in case of an open field circuit.

Hold on coil also known as NVC hold.

NVC is designed in such a way that it holds the handle in 'RUN' position against the force of the spring as long as supply is given to the motor.

3. In motor applications, efficiency of the motor is always less than 100% due to conversion of the .....

(a) Output energy into heat

(b) Input energy into heat

(c) Input energy into voltage

(d) Output energy into current

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : In motor applications efficiency of the motor is always less than 100% due to conversion of the input energy into heat.

$$\text{Efficiency}(\eta) = \frac{\text{Output}}{\text{Input}} = \frac{\text{Output}}{\text{Output} + \text{loss}}$$

Output is less than input due to losses (Heat).

4. How much torque will be produced by the armature of a DC shunt machine if the machine generates 10,000 W of mechanical power in the armature and rotates at the speed of 1500 revolutions per minute?

(a) $\frac{20}{\pi}\text{N}-\text{m}$ (b) $\frac{200}{\pi}\text{N}-\text{m}$

(c) $0\,\text{N}-\text{m}$ (d) $\frac{2}{\pi}\text{N}-\text{m}$

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Ans. (b) : Given that,

P = 10, 000 watt

N = 1500 rpm, T = ?

Torque,

$$T = \frac{P}{\omega} \qquad \left[\because \omega = \frac{2\pi N}{60}\ \text{rad/sec}\right]$$

$$T = \frac{P \times 60}{2\pi N}$$

$$T = \frac{10,000 \times 60}{2\pi \times 1500} = \frac{200}{\pi}\text{N}-\text{m} \Rightarrow \boxed{T = \frac{200}{\pi}\text{N}-\text{m}}$$

5. Which of the following quantities can be changed to control the speed of the brushless DC motor?

(a) Wind pressure

(b) Wind direction

(c) Temperature

(d) Applied DC source voltage

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Ans. (d) : The speed of the brushless DC motor can be controlled if the applied DC source voltage across the motor is changed.

6. Which of the following statements about the losses in a DC motor is INCORRECT?

(a) In series motors, the field ohmic loss forms a part of the armature circuit loss.

(b) Stray load losses are produced due to the distortion of the air gap flux due to armature reaction.

(c) The no load rotational loss is made up of iron loss and mechanical loss.

(d) Brush losses forms a part of mechanical losses.

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Ans. (d) : In the DC motor, Iron losses occurred in armature because the armature core is made of iron and it rotates in a magnetic field hence a small current gets induced in the core. Due to this current eddy current losses and hysteresis losses occurred in the armature. Combined both the losses is also called iron loss or core loss

- Brush losses are the losses taking place between the commutator and the carbon brushes. $P_{BD} = V_{BD}\, I_a$

7. The armature resistance of a 220 volt DC machine is 0.5 ohm. What is the value of the back EMF when the machine functions as a motor if the full load armature current is 25 amps?

(a) 207 V (b) 207.5 V
(c) 210 V (d) 209 V

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

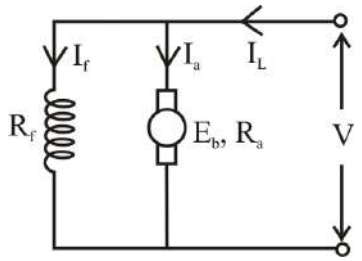
Ans. (b) : Given that,

$V = 220V$

$R_a = 0.5\Omega$

$I_a = 25A$

$E_b = V - I_a R_a$



$E_b = 220 - 0.5 \times 25$

$E_b = 220 - 12.5$

$\boxed{E_b = 207.5V}$ `

8. Which of the following motors do/does NOT use three-point starters ?

(a) DC shunt motor
(b) DC series motor
(c) DC compound motor
(d) Both DC shunt and compound motors

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : DC series motor does not use 3-point starters because if we connect dc series motor terminal to line (L) and armature (A) terminal of starter then field terminal of starter will be left open and therefore no current will flow through NVR (no volt relay) as NVR is connected in series with field control circuit of starter.

9. Which of the following parts is NOT present in a typical brushless DC motor ?

(a) Fixed armature (b) Commutator
(c) Electronic controller (d) Permanent magnet

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Ans. (b) : A brushless DC motor avoid the need for a commutator and brushes by having its permanent magnets in the rotor.

- As brushes are absent, the mechanical energy loss due to friction is less which enhanced efficiency.
- BLDC motor accelerate and decelerate easily as they are having low rotor inertia.

10. Which of the following motors is used for shears and presses ?

(a) DC shunt motor (b) DC compound motor
(c) Stepper motor (d) DC series motor

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : DC compound motor is used for shears and presses, DC compound motors can be used where we require high starting torque and constant speed.

iii. Transformer (Single Phase and Three Phase)

11. The no load ratio of a 50 Hz single-phase transformer is 2000/200 V. The maximum flux in the core is 0.05 Wb. What is the approximate number of primary turns?

(a) 100 turns (b) 180 turns
(c) 200 turns (d) 145 turns

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given,

$f = 50$

$V_1 = 2000V$, $V_2 = 200V$

$\phi = 0.05Wb$

$\because \quad V_1 = 4.44 f \phi N_1$

$2000 = 4.44 \times 50 \times 0.05 \times N_1$

$\Rightarrow \quad N_1 = \dfrac{800}{4.44} = 180.18$

$\boxed{N_1 = 180 \text{ turns}}$

12. Which expression is right about EMF equation of a transformer if f = frequency, N_1 = number of turns in primary, φ_m maximum flux in a core, A = iron area, B_m = Maximum flux density?

(a) $E = 4.44 f N_1 \varphi_m A$ (b) $E = 4 f N_1 \varphi_m A$
(c) $E = 4.44 f N_1 \varphi_m$ (d) $E = 4.44 f N_1 B_m$

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : EMF equation of transformer,

$E = 4.44\, f\, N_1 \phi_m$

f = frequency

N_1 = Number of turns in primary

ϕ_m = Maximum flux in core

A = Iron Area.

B_m = Maximum flux density

13. The load on the transformer changes every day, with a daily production of 120 kWh and a cumulative loss of 5 kWh. What is the all-day efficiency of the transformer?

(a) 95% (b) 96%
(c) 90% (d) 92%

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Output load = 120 kWh

loss (W) = 5kWh

$$\text{all day Efficiency } (\eta) = \frac{\text{Output in kWh for 24 hours}}{\text{Input in kWh for 24 hours}}$$

$$= \frac{120}{120+5} \times 100$$

$$= \frac{120}{125} \times 100 = 96\%$$

14. Which of the following connections is used as distribution transformer?

(a) Star-star (b) Star-delta

(c) Delta-star (d) Delta-delta

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Delta-star connections is used as distribution transformer because neutral point on secondary side is maintained stable and the transformer can able to supply 1-ϕ and 3-ϕ loads perfectly.

This transformer connection is generally employed at beginning of the transmission line as a step up transformer.

15. A supply of 200 V can be obtained from a source of 600 V by means of a two-winding transformer or an auto transformer. The ratio of weights of conductor material in the auto transformer with respect to the two-winding transformer is .....

(a) 1.2:1 (b) 1:1.5

(c) 1.5:1 (d) 1:2

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) :

$$a_{auto} = \frac{V_H}{V_L} = 3$$

$$(\text{Cu -weight})_{auto} = \left(1 - \frac{1}{a_{auto}}\right)(\text{Cu} - \text{weight})_{2-wdg}$$

$$\frac{(\text{Cu} - \text{weight})_{auto}}{(\text{Cu} - \text{weight})_{2-wdg}} = \left(1 - \frac{1}{3}\right) = \frac{2}{3}$$

$$= \frac{1}{1.5}$$

$(\text{Cu-weight})_{auto} : (\text{Cu-weight})_{2\text{-}wdg} = 1:1.5$

16. Which of the following types of steel is used to make the core of a transformer?

(a) Tool steel (b) Stainless steel

(c) Silicon steel (d) High-carbon steel

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Silicon steel is used to make the core of a transformer.

- Silicon steel is a ferromagnetic material. This has superior magnetic property.
- It has low hysteresis coefficient x = 1.6

17. The following test results were obtained from a 6 kVA, 200/400 V. 50 Hz single-phase transformer: Data for no-load low-voltage side: 200 V, 0.5 A and 50 W. At normal voltage and frequency, determine the magnetizing current of the transformer.

(a) 0.569 A (b) 0.236 A

(c) 0A (d) 0.433 A

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given,

$P_0 = 50W$, $I_0 = 0.5A$

$V_1 = 200V$

No load power $P_0 = V_1 I_0 \cos\phi_0$

$P_0 = V_1 I_w$

$$I_W = \frac{P_0}{V_1} = \frac{50}{200} = 0.25$$

$$I_0^2 = I_m^2 + I_w^2$$

$$I_m^2 = (0.5)^2 - (0.25)^2$$

$$\boxed{I_m = 0.433A}$$

18. The phasing out test on a three-phase transformer is carried out to find.....

(a) Secondary winding belonging to a different phase

(b) Primary winding belonging to the same phase

(c) Primary and secondary winding belonging to the same phase

(d) Primary and secondary windings belonging to a different phase

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The phasing out test on a three phase transformer is carried out to find primary and secondary winding belonging to the same phase.

This test carried out only on 3 phase transformers to indentify primary and secondary winding belonging to the same phase.

19. Which of the following is NOT an advantage of shell type transformers over core type transformers?

(a) Less copper requirement

(b) Easy maintenance

(c) Reduced loss

(d) High mechanical strength

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

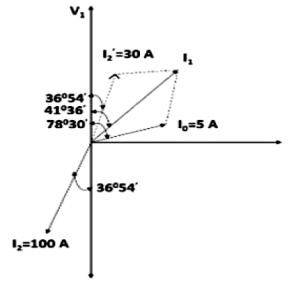
Ans. (b) : Advantage of shell type transformer over core type transformer-

(i) Less copper requirement

(ii) Reduced loss

(iii) High mechanical strength

20. Find the estimated current taken by the primary side if a single-phase transformer with a voltage ratio of 440/110 V takes a no-load current of 5 A at 0.2 power factor lagging and the secondary supplies a current of 120 A at a power factor of 0.8 lagging. Given that cos(41°36') = 0.748.



(a) 30 A (b) $\sqrt{1178}$ A

(c) $\sqrt{1149.4}$ A (d) $\sqrt{1140.4}$ A

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Given,

$I_2^{'} = 30A$

$I_0 = 5A$

$$I_1 = \sqrt{\left(I_2^{'}\right)^2 + \left(I_0\right)^2 + 2I_2^{'} \times I_0 \cos\phi}$$

$$= \sqrt{(30)^2 + (5)^2 + 2 \times 30 \times 5 \times \cos 41^\circ 36'} = \sqrt{1149.4}A$$

21. What will be the primary current of a 20 kVA, 6600/220 V, 50 Hz step-down ideal transformer?

(a) 1.3 A (b) 0 A

(c) 1.515 A (d) 3.03 A

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Given that,

KVA rating of transformer = 20kVA

Primary voltage (V_1) = 6600V

Primary current (I_1) = $\dfrac{20 \times 10^3}{6600}$

$\boxed{I_1 = 3.03A}$

22. The Ohmic loss during the open-circuit test to considered negligible because:

(a) The Ohmic loss is proportional the square of the applied current, which is high in the open-circuit test

(b) The Ohmic loss is proportional to the square of the applied current, which is low in the open-circuit test

(c) The Ohmic loss is proportional to the square of the applied voltage, which is low in the open-circuit test

(d) The Ohmic loss is proportional to the square of the applied voltage, which is high in the open-circuit test

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : The ohmic loss during the open circuit is considered negligible because the ohmic loss is proportional to the square of the applied current, which is low in the open circuit test.

• No load test is performed under no load conditions, no load current is much lesser than the normal current, only a small value of magnetizing current is required. So we neglect the copper loss and consider only the core less in open-circuit test.

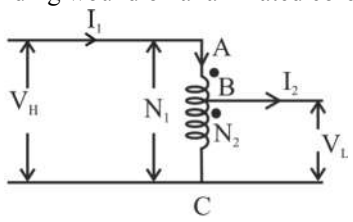
23. How many windings are present in auto transformers?

(a) 2 (b) 3

(c) 4 (d) 1

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : An autotransformer is a transformer with only one winding wound on a laminated core.



$$\boxed{(a)_{auto} = \frac{V_H}{V_L} = \frac{N_1}{N_2}}$$

24. In a transformer, the variation of which quantity leads to induce an EMF?

(a) Frequency (b) Voltage

(c) Magnetic flux (d) Current

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : A varying current in any coil of the transformer produces a varying magnetic flux in the transformer core, which induced a varying electromotive force (emf) across any other coils wound around the same core.

$\boxed{E = 4.44fN\phi}$

25. What is the purpose of laminating the core of a transformer ?

(a) To increase the eddy current loss

(b) To make the core heavier

(c) To minimize the eddy current loss

(d) To induce eddy current loss

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The transformer core is designed to prevent circulating electric currents within the iron core itself. Circulating eddy current causes heating and energy losses within the core. These losses are due to mainly voltages induced in the iron circuit. To reduce these unwanted power losses is to construct the transformer core from thin steel laminations to channelize the currents.

26. Which of the following statements is/are true regarding all day efficiency of a transformer ?

(i) All day efficiency is also called as commercial efficiency.

(ii) All day efficiency primarily depends on the duration of load and amount of load.

(iii) All day efficiency is achieved when the iron losses are less.

(a) Both (i) and (iii) are true

(b) Only (i) is true

(c) Only (ii) is true

(d) Both (ii) and (iii) are true

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : All day efficiency is also known as operational efficiency on the basis of usable energy, we estimate the all day efficiency for a specific time (during the 24 hour) and it can be calculated by-

$$\text{All day efficiency} = \frac{\text{Output (in kWh)}}{\text{Input (in kWh)}}$$

- All day efficiency primarily depends on the duration of load and amount of load. Due to load varies throughout the day, the all day efficiency will be lower than commercial efficiency

27. What is the reason for providing corrugated or radiators on the sides of transformer tanks ?

(a) To increase the dielectric strength of the oil
(b) To provide very small surface area to dissipate heat generated
(c) To reduce the size of the transformer tank
(d) To provide sufficient cooling area

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : To provide sufficient cooling area is the reason for providing corrugated or radiators on the sides of transformer tanks.

28. What is the magnetizing current of a transformer ?

(a) The current flowing through the ferromagnetic core.
(b) The current flowing through the insulation between the primary and secondary windings.
(c) The current drawn by the secondary winding when a load is connected.
(d) The current drawn by the primary winding when the secondary is on open circuit.

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : It is the current that flows in the primary winding of a transformer to establish the magnetic flux in the transformer core. It is also known as the exciting current and it is required to create a magnetic field in the transformer that will induce the voltage in the secondary winding.

29. What is core-stepping in core-type transformers ?

(a) A method to reduce the length of the mean turn
(b) A method to increase the length of the mean turn
(c) A method to increase the R loss
(d) A method to reduce the space factor

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : The diameter of the circumscribing circle for square/rectangular coil is larger than the diameter of stepped core of same area of cross section therefore the length of mean turns of winding is reduced in the stepped core. Therefore the length of mean turns in the stepped core reduced which result in reduction of copper winding cost and copper losses.

30. In a phasing out test, a voltmeter connected to the winding shows deflection when the supply is given; this indicates that this is _____.

(a) tertiary winding only
(b) secondary winding only
(c) primary winding only
(d) both primary and secondary winding

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : In a phasing out test, a voltmeter connected to the winding shows deflection when the supply is given, this indicates that this is secondary winding.

31. Which of the following information is NOT present on the nameplate of a transformer?

(a) Rated frequency
(b) Insulation class
(c) kVA or MVA rating
(d) Frame size

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Frame size is not mentioned on the name plate of a transformer.

Important data that is mentioned on name plate is as follows-

- Manufacturer name and year of manufacturing.
- Rated frequency
- Insulation class
- KVA or MVA rating
- Number of Phases
- Connection diagram
- Voltage ratings
- Serial Number

32. What is the purpose of interleaving the windings in a transformer ?

(a) To reduce the efficiency of the transformer
(b) To increase the leakage flux
(c) To reduce the leakage flux
(d) To increase the inductance of the transformer

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : When AC supply is given to the primary of transformer flux is developed in the core, in this magnetic flux there is some flux linked with air that is known as leakage flux. To reduce this leakage flux interleaving of the transformer winding is done.

33. Which of the following types of cooling is more economical for very large transformers of rating 100 MVA?

(a) Oil forced water forced
(b) Oil forced air forced
(c) Oil natural air forced
(d) Oil natural air natural

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : When transformer is in working condition it heats up, as the rating of transformer increases it requires more effective cooling methods to maintain the temperature of the transformer. When rating is 100 MVA, oil forced water forced types of cooling method is used. Oil natural and air forced method of cooling can be used up to 60 MVA. Oil natural and air natural method of cooling is used up to 30 MVA. Air blast methods is used up to 15 MVA.

iv. Alternator (Synchronous Generator)

34. What type of rotor is used in alternators driven by hydro-turbines?
(a) Smooth cylindrical type
(b) Non-salient pole type
(c) Shaded pole type
(d) Salient pole type

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Salient pole type rotor is used in alternators driven by hydro-turbines.
- The salient pole type rotors are suitable for hydroelectric power station and diesel power stations.
- Cylindrical rotor is used in alternator driven by steam turbines and gas turbines.

35. At the leading power factor, the armature reaction of an alternator is:
(a) Partially cross magnetising and partially demagnetising
(b) Wholly demagnetising
(c) Wholly magnetising
(d) Partially cross magnetising and partially magnetising

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : At leading power factor, the armature reaction of an alternator is partially cross magnetizing and partially magnetizing.

Power factor	Alternator	Motor
Unity	Purely cross magnetizing	Purely cross magnetizing
ZPF lag	Purely demagnetizing	Purely magnetizing
ZPF lead	Purely magnetizing	Purely demagnetizing
Lagging	Partially demagnetizing + partially cross magnetizing	Partially magnetizing + partially cross magnetizing
Leading	Partially magnetizing +partially cross magnetizing	Partially demagnetizing + partially cross magnetizing.

36. What is the main reason of placing field winding on the stationary rotor?
(a) Stator is associated with more power
(b) Field circuit possesses less power
(c) Stator is associated with more current
(d) Insulation of high voltage is made easy on stator than on rotor

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Reasons for placing field winding on the rotor, not on the stator-
Armature winding deals with the high levels of voltages, hence it is easier to insulate a stationary winding as compared to rotating winding. The stationary 3-phase armature can be directly connected to load without slip rings and brushes.

37. Which of the following statements accurately describes voltage drop due to armature leakage reactance in an alternator on load?
(a) The voltage drop due to armature leakage reactance only occurs when the alternator is operating at no load.
(b) The voltage drop due to armature leakage reactance is independent of the load
(c) The voltage drop due to armature leakage reactance increases with increasing load
(d) The voltage drop due to armature leakage reactance decreases with increasing load

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Whenever the load on the alternator is varied, the terminal voltage will also vary this variation in terminal voltage is mainly due to three reasons-voltage drop due to armature resistance IR_a, the voltage drop due to armature leakage reactance IX_a, and voltage drop due to armature reaction.
The voltage drop due to armature leakage reactance increases with increasing load.

38. Which of the following statements is NOT correct about the significance of stationary armature alternator?
(a) The armature windings can be braced better mechanically against the high electromagnetic force.
(b) The output current can be easily taken from rotor winding
(c) The rotating field type alternator has a smaller size than the rotating armature type
(d) The armature windings of the rotating field alternator are not subjected to centrifugal forces.

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Significance of stationary armature alternator-
(i) Armature winding can be braced better mechanically against the high electromagnetic force.
(ii) The rotating field type alternator has a smaller size than the rotating armature.
(iii) The armature winding of the rotating field alternator are not subjected to centrifugal force.
(iv) The output current can be easily taken from stator winding.

39. Calculate the line value of induced emf of a 10-pole, 3-phase, 60 Hz star-connected alternator with 60 slots and 4 conductors per slot. The value of the pitch factor is 0.966, the distribution factor is=0.966, the flux per pole is 0.12 Wb and it is sinusoidally distributed.
(a) 1193.4 V (b) 2066.76V
(c) 688.92 V (d) 927.36 V

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,
$P = 10$, $f = 60$ Hz, $k_p = 0.966$, $k_d = 0.966$
$\phi = 0.12$Wb

No. of turn per phase $= \dfrac{60 \times 4}{2 \times 3} = 40$

$E_{ph} = 4.44 f N_{ph} \phi k_p k_d$
$E_{ph} = 4.44 \times 60 \times 40 \times 0.12 \times 0.966 \times 0.966$
$E_{ph} = 1193.24$V
$E_{Line} = \sqrt{3} E_{ph}$

$$\boxed{E_{Line} = \sqrt{3} \times 1193.24 = 2066.76\text{V}}$$

40. Which of the following statements is NOT correct about generation of alternating voltage?
(a) An increase in the number of poles, increases the frequency.
(b) A 4-pole generator completes four cycles per revolution.

(c) For the production of voltage, either the armature or the field rotates.
(d) The number of times the armature rotates per second, the same number of cycles will be produced by the armature voltage.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : For synchronous machine-

$$\boxed{N_S = \frac{120f}{p}}$$

In synchronous machine speed always constant

$$\boxed{P \propto f}$$

$$\boxed{\theta_e = \frac{p}{2}\theta_m}$$

For p = 4

$$\theta_e = \frac{4}{2}\theta_m = 2\theta_m$$

$$\boxed{\theta_e = 2\theta_m}$$

If number of the pole is four, it means two cycles induced voltage in one revolution.

41. Which of the following statements is true regarding the voltage drop due to armature reaction for unity power factors in an alternator?
(a) The voltage drop is maximum for unity power factors.
(b) The voltage drop is zero for unity power factors.
(c) The voltage drop remains constant irrespective of the power factor.
(d) The voltage drop is minimum for unity power factors.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : The voltage drop is minimum for unity power factors.
At the unity power factor, the armature reaction voltage drop E_{ar} leads the armature current I_a which produced it, and is therefore always in phase with the armature reactance voltage drop (I_aX_a)

42. The armature reaction effect is high in ——.
(a) Series parallel control method
(b) Both the armature and field control methods
(c) Field control method
(d) Armature control method

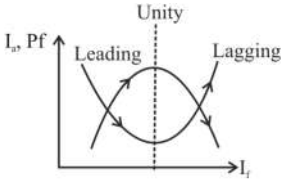
SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : The armature reaction effect is high in field control method because commutation becomes unsatisfactory. Field control method is economical, more efficient and convenient and it can gives speeds above the normal speed.

43. Which of the following statements is true regarding the voltage drop due to armature reaction for leading power factors in an alternator ?
(a) The voltage drop increases with an increase in power factor.
(b) The voltage drop remains constant irrespective of the power factor.
(c) The voltage drop is not affected by the power factor.
(d) The voltage drop decreases with an increase in power factor.

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : In an alternator, the voltage drop decrease with an increase in power factor (for leading power factor).
From the V- curve and inverted V- curve-



44. A 3-phase star-connected alternator is rated at 1.3 MVA, 11 KV, The armature effective resistance and synchronous reactance are 1.3 Ω and 20 Ω, respectively. Calculate voltage drop due to synchronous reactance.
(a) 930.77 V (b) 2363 V
(c) 1364.6 V (d) 842.24 V

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Given that,
S= 1.3 MVA, V= 11 KV, $(r_a)_{eff} = 1.3\Omega$
$X_s = 20\Omega$
Then, S= $\sqrt{3}$ VI

$$I = \frac{1.3\times10^6}{\sqrt{3}\times11\times10^3}$$

I = 68.23 Amp
Voltage drop due to synchronous reactance-
$V = I.X_s$
$V = 68.23\times20$

$$\boxed{V = 1364.6\ V}$$

45. The type of armature winding used in large high-voltage alternators is:
(a) wave winding (b) two layer winding
(c) concentric winding (d) lap winding

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : concentric winding is that kind of winding which generates maximum emf. In this winding poles and number of slots are equal that means one coil side is placed under one pole and other coil side is placed in next slot under next pole.

46. As the leading power factor of the load of an alternator decreases, the magnitude of generated voltage required to give rated terminal voltage _____.
(a) remains unchanged
(b) increases
(c) first increases and then decreases
(d) decreases

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The voltage drop of an alternator depends on following factors-
(i) Armature reaction
(ii) Armature circuit voltage drop
(iii) Armature reactance
The nature of the load affects the voltage regulation of the alternator. When the leading power factor of the load of an alternator decreases, the magnitude of generated voltage required to given rated terminal voltage increases.

Chapter-3 Electrical Machine-II

i. Three Phase Induction Machine

1. Which of the given statements is NOT true about the double layer winding in the electrical machine?

(a) Easier to manufacture and lower cost of the coils
(b) Improved emf waveform will be there.
(c) Fractional slot winding can be possible.
(d) Leakage reactance will be more as more winding is there.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Advantage of double layer winding in the electrical machine-

- Easier to manufacture and lower cost of the coils
- Improved emf waveform will be there.
- Fractional slot winding can be possible.
- Lower leakage reactance.

2. Power factor of an IM is low at _____.

(a) half load (b) no load
(c) full load (d) quarter load

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : At no load, an induction motor draws a large magnetizing current and a small active component to meet the no-load losses. Therefore, the induction motor takes a high no- load current lagging the applied voltage by a large angle.
Hence the power factor of an induction motor at no load is low (Approx 0.2 to 0.4)

3. Select the INCORRECT statement(s) regarding squirrel-cage induction generators used in wind power plants.

A) They can be used in both constant-speed and variable-speed applications.
B) They work within a narrow speed range, which is slightly above the synchronous speed.
C. Squirrel-cage induction generators are more expensive than wound-rotor induction generators.

(a) Only C (b) Only A
(c) A and B (d) Only B

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Squirrel- cage induction generator-

- This generator is simple in construction and coupled to the turbine through gear box. It is a constant speed generator.
- It can be used in both constant - speed and variable - speed application.
- Squirrel-case induction generators are less expensive than wound - rotor induction generator.

ii.AC Single Phase Induction Motor and Special Type of Motor

4. The shaded-pole induction motors have _____ compared with other motor types and may not be suitable for applications with _____ or where precise speed control is necessary.

(a) high efficiency; light loads
(b) lower efficiency; heavy loads
(c) high efficiency; heavy loads
(d) lower efficiency; light loads

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The shaded- pole induction motors have lower efficiency compared with other motor types and may not be suitable for applications with heavy loads or where precise speed control is necessary.
Shaded pole induction motor is a low cost, small size motor which is mainly used in toys and hair dryers etc.

5. What is the use of encoder in the DC servomotor?

(a) Determines the temperature of the windings of the motor
(b) Determines the input voltage of the motor
(c) Determines the magnetic field strength inside the motor
(d) Determines the rotational speed of the motor

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : The use of encoder in the DC servomotor is determines the rotational speed of the motor.
A servomotor is an electric motor used in a servomechanism, a device that uses a closed loop control circuit to automatic mechanical motion.
Components-servo amplifier (driver), encoder, controller.

6. The split-phase induction motor is NOT used for drives that require more than.....

(a) 10 kW (b) 1 kW
(c) 100 kW (d) 1000 kW

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The split phase induction motor is not used for drives that require more than 1kW because of the low starting torque.
It is suitable for easily starting loads where the frequency of starting is limited.
For same weight, its rating is about 60% that of the poly-phase motor. The split phase induction motor has lower power factor and lesser efficiency.

7. Repulsion start induction run motors are used in applications such as.....

(a) Compressors (b) fans
(c) vacuum cleaners (d) hair dryers

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Repulsion start induction run motor are used in applications such as compressors.
The motor is started as a repulsion motor with a corresponding high-starting torque. At some predetermined speed a centrifugal switch short-circuits the commutator segments so that the motor operates as a 1-phase induction motor.

8. Consider the following statements about the working of a hysteresis motor and choose the suitable combination for correct choices.

a. The stator of the hysteresis motor has a main winding along with an auxiliary winding.

b. When the stator winding is fed from a single phase supply, it produces a synchronously revolving magnetic field.

c. The rotor material has low retentivity so hysteresis loss is low.

d. The rotor of the hysteresis motor consists of a smooth cylinder of magnetically hard steel, without winding

(a) Only c is correct
(b) Only d is correct
(c) Only b, c and d are correct
(d) Only a, b and d are correct

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Hysteresis motor-

(i) The stator of hysteresis motor has a main winding along with an auxiliary winding.
(ii) When the stator winding is fed from a single phase supply, it produces a synchronously revolving magnetic field.
(iii) The rotor of hysteresis motor consists of a smooth cylinder of magnetically hard steel without winding.
(iv) The rotor material has high retentivity and because of this it is very difficult to change the magnetic property once they are caused by the revolving flux of the rotor.

9. A switched reluctance motor can produce torque at a speed .....

(a) Double than synchronous speed
(b) Triple than synchronous speed
(c) Equal to synchronous speed
(d) Less than synchronous speed

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : A switched reluctance motor (SRM) can produce torque at a speed equal to synchronous speed. Reluctance motor cannot accelerate high inertia load to the synchronous speed.

10. In a capacitor-start capacitor-run induction motor, under standstill condition forward and backward voltages are.....

(a) Equal in magnitude (b) Infinite
(c) Zero (d) Unequal in magnitude

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : In a capacitor start capacitor run induction motor, under standstill condition forward and backward voltage are equal in magnitude.

11. In AC series motor, power factor is low because of .....

(a) High resistance of the field and armature circuit
(b) Low inductance of the field and armature circuit
(c) High capacitance of the field armature circuit
(d) High inductance of the field and armature circuit

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : In ac series motor, power factor is low because of high inductance of the field and armature circuit.

12. In the split-phase induction motor, both main winding and starting winding are displaced..... in space.

(a) 360 degrees (b) 180 degrees
(c) 90 degrees (d) 270 degrees

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : In the split-phase induction motor, both main winding and starting winding are displaced 90 degree in space.
The main winding has very low resistance and a high inductive reactance whereas the starting winding has high resistance and low inductive reactance.
Split phase motor is also known as a resistance start motor.

13. Which of the following materials is used to construct the rotor of variable reluctance stepper motor with salient poles?

(a) Ferromagnetic (b) Paramagnetic
(c) Diamagnetic (d) Nonmagnetic

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Ferromagnetic material is used to construct the rotor of variable reluctance stepper motor with salient poles.
• Variable reluctance stepper motor has motion in steps with respect to increase in time and constructed of ferromagnetic material with salient poles.

14. Which of the following is a desirable characteristic of a DC servomotor?

(a) Slow response
(b) Big size of the machine
(c) Less robust
(d) Less inertia

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Servomotor: The motors which respond to the error signal abruptly and accelerate the load quickly are called the servomotor.
These motors have following features:
(i) They are capable of developing high torque and hold a static position.
(ii) Because of low inertia, they are able to accelerate, de-accelerate and reverse its direction of rotation quickly.
Hence low inertia, high torque & high acceleration are desirable characteristics of a dc servomotor.

15. How many terminals does a servo-motor contain?

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

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Servomotor has three terminals.
(i) Phase wire (ii) Ground wire (iii) control terminal.

16. What will happen with a single-phase induction motor that has a short-circuited capacitor?

(a) Will run
(b) Will run in the reverse direction
(c) Will run in the same direction with less speed
(d) Will not run

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : When the capacitor of a single-phase induction motor is short circuit, the motor will not run, because when the capacitor is short circuited, it effectively removes the phase difference between the main winding and the auxiliary winding. The capacitor is connected in series with the auxiliary winding. The capacitor and auxiliary winding create a phase difference between the two windings, which generates the starting torque.

17. In a single value capacitor run motor, the starting torque is about _____ of rated torque.

(a) 10 to 30% (b) 10 to 20%
(c) 20 to 30% (d) 50 to 100%

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

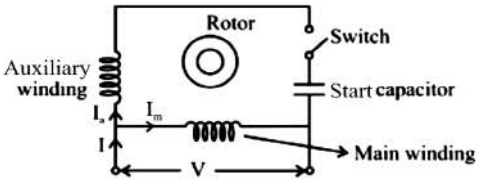
Ans. (d) : In a single value capacitor run motor, the starting torque is about 50 to 100% of the rated torque.

18. In a capacitor start induction run motor, when motor reaches to _____ of full speed, the centrifugal switch S opens and cuts out capacitor from supply.

(a) 25% (b) 50%
(c) 75% (d) 100%

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : In a capacitor start induction run motor, when motor reaches to 75% of full speed, the centrifugal switch (S) open and cuts out capacitor from supply.



19. In a shaded-pole induction motor, in the core, when a _____ phase is applied, a/an _____ flux is generated.

(a) Single; constant (b) Three; alternating
(c) Single; alternating (d) Three; constant

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : In a shaded-pole induction motor, in the core when a single phase is applied, an alternating flux is generated.

- Shaded-pole induction motor rotate a fixed direction from unshaded-pole to shaded pole.
- Low starting torque
- Low efficiency (due to shading ring)
- Low power rating.

20. In a shaded-pole induction motor, the part with copper ring is known as _____, and the copper ring is known as _____, which is usually a single-turn coil.

(a) Shaded pole; shading coil
(b) Shaded pole; shading pole
(c) Shaded coil; shading coil
(d) Shaded coil; shading pole

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : In a shaded-pole induction motor, the part with copper ring is known as shaded pole, and the copper ring is known as shading coil that is usually a single-turn coil.

- In shaded-pole inductor motor shading ring or shading band made of copper.
- A shaded-pole induction motor has low starting torque.
- Low efficiency
- Low power rating

Applications- Toy, Electric clock etc.

21. In a shaded-pole induction motor, the main core flux is _____ by the flux in the ring that is developed by the _____ current.

(a) Supported; circulating
(b) Opposed; constant
(c) Opposed; circulating
(d) Supported; constant

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : In a shaded-pole induction motor, the main core flux is opposed by the flux in the ring that is developed by the circulating current.

- The main motor flux and the shaded ring flux are 90º phase displacement to each other.
- Shaded pole induction motor has low starting torque.
- Shaded pole induction motor has low efficiency.

22. In the split-phase induction motor, the starting torque of the resistance start motor is about _____ the full load torque.

(a) 150 times (b) 15 times
(c) 1.5 times (d) 0.15 times

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : In the split-phase induction motor, the starting torque of the resistance start motor is about 1.5 times the full load torque.

- The maximum or pull- out torque is about 2.5 times full- load torque at about 75% of synchronous speed and also the motor has a high starting current which is usually 7 to 8 times the full load value.

23. Which of the following is NOT the requirement of a DC servomotor ?

(a) Better precision
(b) Less torque to weight ratio
(c) Linear torque-speed characteristics
(d) High accuracy

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The requirements of the DC servomotor:

- It Provides quick torque response.
- Better precision.
- High accuracy.

24. In the spilt-phase induction motor, maximum torque is about _____ the full load torque at about 75% of the synchronous speed.

(a) 250 times (b) 2.5 times
(c) 0.25 times (d) 25 times

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : In the split- phase induction motor, the maximum or pull-out torque is about 2.5 times full load torque at about 75% of the synchronous speed and also the motor has a high starting current which is usually 7 to 8 times the full load value.

25. A repulsion start induction run single phase motor runs as an IM only when _____.

(a) short circuit is disconnected
(b) stator winding is reversed
(c) the commutator segments are short circuited
(d) brushes are shifted to neutral phase

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : A repulsion start induction run single phase motor runs as an IM only when the commutator segments are short circuited.

26. Which of the following is NOT an application of shaded-pole induction motor?

(a) Fans for refrigeration
(b) A lift of a building
(c) Table fan
(d) Hair drier

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : A shaded pole induction motor is a simple single phase induction motor in which part of the main pole is shaded by the copper ring. This motor has very low power factor, low starting torque and poor efficiency.

Applications of shaded pole induction motor-

- Fans for refrigeration
- Exhaust fans
- Hair dryers
- Table fans
- Projectors etc

A lift of a building is not an application of shaded- pole induction motor.

27. The shaded-pole induction motors are of _____.

(a) low cost (b) very high cost
(c) zero cost (d) high cost

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : The shaded pole induction motor is a low cost, small size, low starting torque induction motor. It is used in low power appliances like toys, hair dryers, projectors, refrigerators etc.

iii.Synchronous Motor

28. Mechanical losses in a synchronous motor include:

(a) Joule losses in the rotor winding
(b) Eddy current losses in the stator
(c) Friction and windage losses
(d) Core losses in the laminations

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Mechanical losses in a synchronous motor include friction and windage losses. The friction losses occur due to the friction in the moving parts such as bearing etc.

29. If the synchronous speed of a motor is 1000 rpm and the rotor speed is 970 rpm, then percentage slip is .....

(a) 9% (b) 5%
(c) 7% (d) 3%

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : $N_S = 1000$ rpm

$N_r = 970$ rpm

Percentage slip (s) $= \frac{N_s - N_r}{N_S} \times 100 = \frac{1000 - 970}{1000} \times 100$

$= 3\%$

30. During working of permanent magnet synchronous motor, ...

(a) Rotor produces constant magnetic field and stator produces rotating magnetic field
(b) Stator and rotor both produce constant magnetic field
(c) Rotor produces rotating magnetic field and stator produces constant magnetic field
(d) Stator and rotor both produce rotating magnetic field

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : During working of permanent magnet synchronous motor, rotor produces constant magnetic field and stator produces rotating magnetic field.

31. Which of the following statements is FALSE in association with synchronous motor applications?

(a) Synchronous motor is used constant drive application.
(b) Synchronous motor is expensive in low power output application.
(c) Voltage regulation can be done using synchronous motor.
(d) Synchronous motor is highly suitable for low power output below 40 kW in medium speed range.

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Synchronous motor applications-

(i) Synchronous motor is constant drive application.
(ii) Synchronous motor is expensive in low power output application.
(iii) Voltage regulation can be done using synchronous motor.
(iv) Synchronous motor are more suitable for applications that need constant speed, high power or precise control.

32. The advantage of the stationary armature of a synchronous machine is:

(a) Commutator is present
(b) Stator weight is less compared to rotor weight
(c) Stator winding voltage rating can be decreased
(d) Perfect mechanical balance is obtained on stator winding

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : The advantage of the stationary armature of a synchronous machine is perfect mechanical balance is obtained on stator winding.

33. Consider the following statements about damper winding used to start a synchronous motor and choose the suitable combination of correct choices.
a) When a motor is overloaded it does not stop.
b) Synchronous motor made self-starting by providing damper winding.
c) Damper winding consists of short-circuited copper bars embedded in the face of the field poles.
d) Since damper winding resistance is high so it takes a small current from the supply mains.
(a) All a, b, c, d are true.
(b) Both b and c are true.
(c) Both b and d are true.
(d) Only a, b and c are true.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Damper winding:
- Damper winding is made with low resistance copper, aluminium, or brass. They are inserted in the slots made under the pole shoe.
- Synchronous motor made self starting by providing damper winding.
- Damper winding consists of short circuited copper bars embedded in the face of the field poles. Damper winding in synchronous motor prevents hunting, so when a motor is overloaded it does not stop.

34. Which option is INCORRECT in relation to the applications of synchronous motors?
(a) They are used to regulate the voltage at the end of transmission line.
(b) They are used in power house and substation in parallel to the bus bar to improve the power factors.
(c) They are used in factories having a large number of induction motors operated at leading power factor.
(d) The are used in large loads where constant speed is required.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : They are used in factories having large number of induction motor operated at leading power factor is false.
- A synchronous motor operated unity power factor for normal excitation.
- A synchronous motor operated lagging power factor for under excitation.
- A synchronous motor operated leading power factor for over excitation.

35. Identify the FALSE statement associated with the significance of stationary armature in synchronous machine.
(a) The stationary armature is typically housed in a stationary frame, which provides a large surface area for efficient cooling. This allows the armature to operate at high temperatures without overheating, resulting in higher efficiency and longer lifespan.
(b) The stationary armature is responsible for producing the stator magnetic field in a synchronous machine. The magnetic field produced by the armature interacts with the magnetic field produced by the rotor to generate the torque necessary to turn the machine.
(c) The stationary armature is a stationary component that does not rotate, making it less prone to wear and tear. This results in a machine that is highly reliable and requires minimal maintenance.
(d) In stationary armature configuration, the exciting current is relatively high; therefore, the slip rings and brush gear need to be heavy construction.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Significance of stationary armature in synchronous machine-
- The stationary armature is typically housed in a stationary frame, which provides a large surface for efficient cooling this allows the armature to operated at high temperatures without overheating resulting in higher efficiency and longer lifespan.
- The stationary armature is responsible for producing the stator magnetic field in a synchronous machine. The magnetic field produced by the armature interacts with the magnetic field produced by the rotor to generate the torque necessary to turn the machine.
- The stationary armature is stationary component that does not rotate, making is less prone to wear and tear this results in a machine that is highly reliable and requires minimal maintenance.
- Only two slip rings are required for dc supply to the field winding on the rotor. Since the exciting current is small, the slip rings and brush gear required are of light construction.

36. The permanent magnet synchronous motor has a configuration almost identical to the conventional synchronous machine with the absence of _____.
(a) field winding and rotating magnetic field
(b) field winding and slip ring
(c) stationary magnetic field
(d) air gap between stator and rotor

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The permanent magnet synchronous motor (PMSM) has a configuration almost identical to the conventional synchronous machine with the absence of field winding and slip ring.

37. Which option among the following is correctly associated with the 'Auxiliary motor starting' ?
(a) A squirrel cage winding is used for the starting purpose of the starting of the synchronous motor.
(b) A damper winding is used for the starting purpose of the starting of the synchronous motor.
(c) A small direct-coupled induction motor, called pony motor, is used for the starting purpose of the synchronous motor.
(d) A DC supply and DC compound motor is used for the starting purpose of the starting of the synchronous motor.

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Synchronous motors are not self- starting. Some additional devices should be used to start the motor. Basically, there are two method for starting the synchronous motors.
(i) Damper winding starting.
(ii) Auxiliary motor starting.
Auxiliary Motor Starting: The auxiliary motor may be a dc shunt motor or an induction motor having the same number of poles as the synchronous motor or two poles less as compared to synchronous motor. The job of the auxiliary motor is to bring the synchronous motor to synchronous speed or near the synchronous speed.

38. Because of their high efficiency and high speed, synchronous motors are well suited for _____.
(a) ceiling fans (b) electric tractions
(c) mixer grinders (d) blowers

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Because of their high efficiency and high speed, synchronous motors are well suited for blowers.
Synchronous motor is a constant speed motor, it runs at constant speed from no load to full load.

Chapter-4 ELECTRICAL INSTRUMENTS AND MEASUREMENTS

i.Analog Ammeters and Voltmeters

1. For providing controlling torque to a horizontally mounted MI instrument, which of the following methods is used?
(a) Water control (b) Eddy current
(c) Spring control (d) Electrostatic field
SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : For providing controlling torque to a horizontally mounted MI instrument spring control methods is used.
1. Spring control is the most common method of providing controlling torque in electrical instrument.
2. It is a universal instrument which can be used for the measurement of AC and DC quantities.

2. The deflecting torque in a PMMC instrument is proportional to.....
(a) The area of the coil
(b) The current flowing through the coil
(c) The resistance of the coil
(d) The square of the current flowing through the coil
SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The deflecting torque in a PMMC instrument is proportional to the current flowing through the coil.

$\boxed{T_d = NBAI}$ $\boxed{T_d \propto I}$

N = number of turns
B = Flux density
A = Area of core
I = current to be measured.

3. Which of the following statements are INCORRECT about PMMC instruments?
I. The torque-to-weight ratio is high, which gives a high accuracy.
II. A single instrument can be used for several, different current voltage ranges by using the instrument transformer.
III. The scale is uniformly divided.
IV. The cost of PMMC instruments is lower than that of moving iron instruments.
(a) Only II and III (b) Only I and III
(c) Only I and IV (d) Only II and IV
SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Following statements are correct about PMMC instruments:
- The torque to weight ratio is high, which gives a high accuracy.
- The scale is uniformly divided because the response of the instrument is directly proportional to the deflection of the pointer.
- The cost of PMMC instruments is higher than that of moving iron instruments.
- It has the least power consumption (25μW to 200μW) among all kinds of analog instruments.
- PMMC is suitable for direct current measurement only.

Hence statements II and IV are incorrect about PMMC instruments.

4. A moving coil instrument gives a full scale deflection of 10 mA when the potential difference across its terminals is 100 mV. Calculate the shunt resistance for full scale deflection which corresponds to 200 A?
(a) 50.02 mΩ (b) 500.02 μΩ
(c) 50.02 μΩ (d) 500.02 mΩ
SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given,
I_m = 10mA, I = 200A
V_m =100mV, R_{sh}=?

$$\boxed{R_{sh} = \frac{R_m}{(m-1)}}$$

Multiplying factor (m) = $\frac{I}{I_m}$

$$m = \frac{200}{10\times10^{-3}} = 20000$$

$$R_m = \frac{V_m}{I_m} = \frac{100}{10} = 10\Omega$$

$$R_{sh} = \frac{10}{(20000-1)} = 500.02\mu\Omega$$

$$\boxed{R_{sh} = 500.02\mu\Omega}$$

5. The range of a moving iron ammeter can be extended by using a _____.
(a) Shunt connected in parallel with an ammeter
(b) Multiplier connected in parallel with an ammeter
(c) Multiplier connected in series with an ammeter
(d) Shunt connected in series with an ammeter
SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : The range of a moving iron ammeter can be extended by using a shunt connected in parallel with an ammeter
- Moving iron instrument measure both AC & DC quantities
- Scale is non linear
- Moving iron instrument not suitable for measurement of current or voltage for frequency above 125Hz.

6. Which of the following measurement instruments consumes the least amount of energy ?
(a) Induction type (b) Dynamometer type
(c) PMMC type (d) Moving iron type
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The power consumption in PMMC instruments is typically about 25μW to 200μW because driving power is low.

Instrument	Power Consumption
Moving Iron	Less (mW)
Hotwire	High
Induction type	Very high

7. What will be the direction of deflecting torque in a moving iron instrument if the direction of current in the coil is reversed at the same magnitude ?
(a) Reverse direction (b) Reduced by half
(c) Reduced to zero (d) Same direction
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : In moving iron instrument deflecting torque works in the same direction whatever be the direction of current because the deflecting torque is directly proportional to the square rms value of the current.

as $T_d = \frac{1}{2} I^2 \frac{dL}{d\theta}$

8. In a PMMC instrument, if the controlling torque is too high, what effect will it have on the accuracy of the instrument?

(a) The instrument will stop working.
(b) The accuracy of the instrument will increase.
(c) The accuracy of the instrument will decrease
(d) The accuracy of the instrument will remain unaffected.

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : In a PMMC instrument, if the controlling torque is too high, accuracy of the instrument will decrease.

9. An electrodynamometer is widely used as a _____.

(a) calibration instrument
(b) transfer instrument
(c) low impedance circuit
(d) calibration instrument and transfer instrument

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : An electrodynamometer is widely used as a transfer instrument. A transfer instrument is that instrument which is used on AC & DC both with DC calibration.

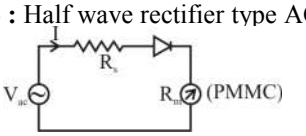
ii. Measurement of Power and Wattmeters

10. The deflection produced by a half wave rectifier type AC voltmeter is how much times the deflection produced by the DC of equal magnitude voltage?

(a) 0.90 times (b) 0.80 times
(c) 0.40 times (d) 0.45 times

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Half wave rectifier type AC voltmeter-



$V_{ac} = V_{rms} = \frac{V_m}{\sqrt{2}}$

$\boxed{V_m = \sqrt{2}\, V_{rms}}$

- $V_{avg} = V_{dc} = \frac{V_m}{\pi}$

$V_{dc} = \frac{\sqrt{2}\, V_{rms}}{\pi} \Rightarrow \boxed{V_{dc} = 0.45 V_{ac}}$

- $I_{avg} = I_{dc} = 0.45\ I_{rms}$

$\boxed{S_{ac} = 0.45\ S_{dc}}$

Hence, the sensitivity of half-wave rectifier instrument with ac is 0.45 times its sensitivity with dc and the deflection is 0.45 times that produces with dc of equal magnitude V.

11. Which of the following statements is/are true in regard to auto transformers?

(i) A commonly known auto transformer, variac is used in laboratories and science labs.
(ii) An auto transformer should have small transformation when used in transmission and distribution application.
(iii) An auto transformer is used to raise the voltage in an AC feeder and is known as booster.

(a) Only (i) (b) Only (ii)
(c) (i) and (iii) (d) (i), (ii) and (iii)

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Following statements are true in regard to auto transformers-

- A commonly known auto transformer, variac is used in laboratories and science labs.
- An auto transformer should have small transformation when used in transmission and distribution application.
- An auto transformer is used to raise the voltage in ac feeder and is known as booster.

iii. Measurement of Energy and Industrial Metering

12. The compensation for light load is done by using a metallic strip provided between the —.

(a) Central limb of shunt magnet and disc
(b) Permanent magnet and disc
(c) Disc and the pointer
(d) Central limb of series magnet and disc

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : The compensation for light load is done by using a metallic strip provided between the central limb of shunt magnet and disc due to this strip an additional torque independent of load is produce which act on the disc in the direction of rotation. This compensates for the friction and meter can be made to read accurately.

13. Which of the following is used with the pressure coil to bring the flux produced by the shunt magnet exactly in quadrature with the applied voltage?

(a) Aluminium shading bands are provided on the central limb
(b) Copper shading bands are provided on the central limb
(c) Aluminium shading bands are provided on the U limb
(d) Copper shading bands are provided on the U limb

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : The copper shading are provided on the central limb of the shunt magnet and they are position-adjustable.
They bring the potential coil flux exactly in quadrature with the applied voltage.

iv. Measurement of Resistance

14. For measuring the earth resistance by the fall-of-potential method, how many auxiliary electrodes are used?

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

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The 3-point method called the "fall of potential" method, comprises the ground electrode to be measured and two other electrically independent test electrodes, usually labeled P (potential) and C (current).

v.Cathode Ray Oscilloscope (CRO)

15. The deflection sensitivity in a cathode ray oscilloscope (CRO) is ..... the mass of electron.

(a) Directly proportional to
(b) Directly proportional to the square root of
(c) Inversely proportional to the square root of
(d) Inversely proportional to

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The deflection sensitivity in a cathode ray oscilloscope (CRO) is inversely proportional to the square root of the mass of electron.

Electrostatics deflection sensitivity $S = \frac{L\ell_d}{2dV_a}$

Magnetic deflection sensitivity $S = LI\sqrt{\frac{q}{m}}\frac{\ell}{\sqrt{2V_a}}$

16. What is the function of the phosphor-coated screen in a CRT?

(a) It is the part that moves the direction of the electron beam
(b) It is the part that regulates the intensity of the electron beam
(c) It is the part that emits light
(d) It is the part that generates a beam of electrons

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The function of the phosphor-coated screen in a CRT is it emits visible light, whose intensity depends on the number of electrons striking on the screen.

17. With respect to measuring the current in a circuit using the CRO, which of the following statements is/are correct?

I. A low-resistance standard resistor is connected in series with the circuit whose current is being measured.
II. The CRO is connected across the standard resistor to measure the voltage drop across it.
III. A high-resistance standard resistor is connected in parallel with the circuit where the current is being measured.
IV. The CRO is connected in series with the circuit whose current is being measured.

(a) Only IV (b) Only I and II
(c) Only III and IV (d) Only I and IV

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : With respect to measuring the current in a circuit using the CRO-
1. A low-resistance standard resistor is connected in series with the circuit whose current is being measured.
2. The CRO is connected across the standard resistor to measure the voltage drop across it.

18. The bandwidth of CRO is the range of frequencies over which gain of _____.

(a) Vertical amplifier is within 5 db of the mid-band frequency gain
(b) Vertical amplifier is within 3 db of the mid-band frequency gain
(c) Horizontal amplifier is within 5 db of the mid-band frequency gain
(d) Horizontal amplifier is within 3 db of the mid-band frequency gain

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : The bandwidth of CRO is the range of frequencies over which gain of vertical amplifier is within 3db of the mid-band frequency gain.

19. How does the input impedance of a CRO affect its deflection sensitivity ?

(a) Lower input impendence leads to higher deflection sensitivity
(b) It is directly proportional at low input impedance and inversely proportional at high input impedance
(c) The input impedance does not affect deflection sensitivity
(d) Higher input impedance leads to higher deflection sensitivity

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Higher input impedance leads to higher deflection sensitivity.
The deflection sensitivity (S) of a CRT is defined as the deflection on the screen (in meters) per volt of deflection voltage.

$$S = \frac{D}{E_d} = \frac{L\ \ell_d}{2dE_a}\ m/V$$

20. To measure the frequency of a waveform, which of the following data is necessary from the CRO ?

(a) Time period of the waveform
(b) Peak to peak value of the waveform
(c) Vertical scale setting
(d) Amplitude of the waveform

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : CRO (Cathode Ray Oscilloscope) is an instrument used to display different waveforms when different types of input signals are given to it.
CRO measures time period and frequency of a waveform, to measure the frequency of a waveform time period of the waveform is necessary.

vi.Miscellaneous Measuring Instruments

21. In commercial multimeters, to obtain the same deflection on corresponding DC and AC voltage ranges, the multiplier for AC range is to be———.

(a) Increased proportionately
(b) Dependent on the duration of testing
(c) Lowered proportionately
(d) Kept the same

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : The commercial multimeter often uses the same scale markings for both its DC and AC voltage ranges. Since the dc component of a sine wave for half-wave rectification equals 0.45 times the rms value, a problem arises immediately. In order to obtain the same deflection on corresponding DC and AC voltage ranges, the multiplier for AC range must lowered proportionately.

Chapter-5 POWER PLANT

i.Thermal Power Plant

1. A coal-fired thermal power plant generates 750 MW of electricity with a thermal efficiency of 30%. The coal has a heating value of 30,000 kJ/kg. Find the mass flow rate of the coal required to generate the required electricity.

(a) 0.0833 kg/s (b) 0.833 kg/s
(c) 83.33 kg/s (d) 8.33 kg/s

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Output power = 750MW

$\eta = 30\%$

E/m = 30, 000 KJ/kg

$\therefore$ Input power $= \frac{750}{30} \times 100 = 2500MW$

$$P_{in} = \frac{E}{t} = \frac{F \times x}{t} = \frac{max}{t}$$

$$\therefore \frac{E}{m} = ax = 30 \times 10^6 J/kg$$

$$\text{then } \frac{m}{t} = \frac{P_{in}}{ax} = \frac{2500 \times 10^6}{30 \times 10^6} = 83.33 kg/s$$

2. In case of thermal efficiency, by using which of the following relations can 1 kWh of electrical energy be converted into joules?

(a) $1kWh = 3.6 \times 10^5$ joules
(b) $1kWh = 36 \times 10^5$ joules
(c) $1kWh = 1.6 \times 10^3$ joules
(d) $1kWh = 36 \times 10^6$joules

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : $1kWh = 10^3 Wh$

$= 10^3 \times 60 \times 60 W.S$

$= 36 \times 10^5$ Joule

3. A power system consists of a coal-fired power plant of 800 MW with the availability factor of 0.8 and a wind farm of 400 MW with the availability factor of 0.5. Find the firm power of the system.

(a) 1800 MW (b) 400 MW
(c) 1200 MW (d) 840 MW

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Given,

Coal fired power plant capacity = 800MW

availability factor = 0.8

wind farm capacity = 400MW

availability factor = 0.5

Firm power, $P = 800 \times 0.8 + 400 \times 0.5$

$P = 640 + 200 = 840$

$\boxed{P = 840MW}$

ii.Hydro Power Plant

4. Which of the following statements regarding the spinning reserve is/are true?

A) It is the reserve capacity which is in operation, but not available for service.
B) It acts as a cushion in case of emergency requirements.
C) It is a capacity which is always connected to the bus and is used in case of need.

(a) A and C (b) Only B
(c) A and B (d) B and C

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : Spinning reserve, It is a capacity which is always connected to the bus and is used in case of need:

- It acts as a cushion in case of emergency requirements.

Hence option (d) is the correct answer.

Note-

Hot reserve: It is the reserve capacity which is in operation, but not available for service.

Cold reserve: It is the generating capacity which is available for service but not normally ready for immediate loading.

5. Select the correct statement(s) with respect to the Francis turbine.

A) It is used in medium heads and for moderate discharges.
B) It is an axial-in radial-out type of turbine.
C) It is an example of a mixed-flow turbine.

(a) A and B (b) A and C
(c) Only A (d) B and C

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The Francis turbine is a reaction turbine which is used in medium heads and for moderate discharges. It is an example of a mixed flow turbine.

iii.Non-conventional Sources of Energy

6. In the wind power plant, which of the following features differentiates the wound rotor synchronous generator from squirrel cage induction generators?

(a) A gearbox is not required in the wound rotor synchronous generator.
(b) The wound rotor synchronous generator includes an external mechanism to control
(c) The wound rotor synchronous generator includes an external mechanism to control the rotor output.
(d) A reactive power compensation unit is not needed in wound rotor synchronous generators.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : In the wind power plant the wound rotor synchronous generators includes an external mechanism to control the rotor output this features differentiate the wound rotor synchronous generator from squirrel cage induction generators.

7. Choose the most efficient generator for wind power generation.

(a) Induction generators
(b) Permanent magnet synchronous generator
(c) Squirrel cage induction generators
(d) Doubly-fed induction generator

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : The most efficient generator for wind power generation is doubly-fed induction generator.
It is based on an induction generator with a multiphase wound rotor and a multiphase slip ring assembly with brushes for access to the rotor winding.

8. Which of the following points clearly describe the need for a back-to-back converter connected to the rotor of a doubly fed induction generator [DFIG] used in wind power plants ?

(i) It feeds the rotor with currents of fixed frequency and thus, helps in achieving a fixed range of speed.
(ii) It feeds the rotor with currents of varying frequency and thus, helps in achieving various ranges of speed.
(iii) It helps in power factor correction by adjusting the active power output of the DFIG.
(iv) It helps in power factor correction by adjusting the reactive power output of the DFIG.

(a) (i) and (iii) (b) (i) and (iv)
(c) (ii) and (iii) (d) (ii) and (iv)

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : There are following two points which clearly describe the need for a back to back converter connected to the rotor of a doubly fed induction generator (DFIG) used in wind power plants.

- It feeds the rotor with current of varying frequency and thus helps in achieving various ranges of speed.
- It helps in power factor correction by adjusting the reactive power output of the DFIG.

9. The actual efficiency of a solar power plant is lower than its theoretical efficiency. Which of the following can be reasons for this?

I) Recombination of electrons and holes
II) Internal resistance of the cell

(a) Only I (b) Only II
(c) Neither I nor II (d) Both I and II

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : The actual efficiency of a solar power plant is lower than its theoretical efficiency.
The following reason for this-
(i) Recombination of electrons and holes.
(ii) Internal resistance of the cell.

10. Arrange the following in the increasing order of energy released during their processing as a biomass.

(A) Bagasse
(B) Municipal solid waste
(C) Wheat and rice straw
(D) Wood pellets

(a) A-B-C-D (b) C-A-B-D
(c) D-B-C-A (d) B-D-A-C

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Increasing order of energy released during their processing as a biomass is given as-
Bagasse < Municipal solidwaste < Wheat and rice straw < wood pellets
hence option (a) is the correct answer.

11. Which type of generator is used in a large wind power plant?

(a) Induction generator
(b) Three phase alternator
(c) DC generator
(d) Slip ring motor

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : Induction generator is used in a large wind power plant and some micro hydro installation due to their ability to produce useful power at varying rotor speeds. Induction generators are mechanically and electrically simpler than other generator types. They are also more rugged, requiring no brushes or commutators.

12. Which of the following components are connected to the gearbox and generator box, respectively, in a horizontal-type wind turbine?

(a) High speed shaft and low speed shaft
(b) Low speed shaft and accelerometer
(c) Low speed shaft and high speed shaft
(d) High speed shaft and accelerometer

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Low speed shaft and high speed shaft are connected to the gearbox and generator box respectively in a horizontal type wind turbine.

13. A wind turbine with a rotor diameter of 60 m is installed in an area with an average wind speed of 4 m/s. Find the wind power density in watts per square metre, assuming that the air density in the area is 1.5 kg/m^3.

(a) 135.67 KW/m^2 (b) 736.45 KW/m^2
(c) 271.3 KW/m^2 (d) 542.6 KW/m^2

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (*) : We know that power of wind

$$P= \frac{1}{2}\rho Av^3$$

then using given values

$$A= \pi\left(\frac{60}{2}\right)^2 = \pi\times 900 = 900\pi$$

$$= 2827.43m^2$$

$$\rho = 1.5kg/m^3$$

$$v = 4m/s$$

then,

$$P= \frac{1}{2}\times 1.5\times 2827.43\times 64$$

$$= 135716.16\ W$$

then power density

$$P_d= \frac{P}{A} = \frac{135716.61}{2827.43}$$

$$= 48W/m^2$$

$$= 0.048\ kW/m^2$$

iv.Economics of Power Generation

14. If a power station supplies 1000 MWh of electricity to its consumers for a period of two months, then the average demand during the period will be:

(a) 0.694 kW (b) 1.39 kW
(c) 1.39 MW (d) 0.694 MW

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Power station supplies energy (E) = 1000MWh

Time (t) = 2month = 60 day

= 60×24 hours

$$\text{Avg demand} = \frac{\text{Energy supplied by power station}}{\text{Total duration}}$$

$$= \frac{1000}{60\times 24} = 0.694\,MW$$

15. Which of the following statements is true about selection of the size of units in electrical energy generation?

(a) The size of units must match both the maximum demand curve and the load curve
(b) The size should be selected independent of both the maximum demand curve and the load curve
(c) The size must be selected such that the unit operates close to the maximum demand curve of the station
(d) The size should be selected such that the unit operates close to the load curve of the station

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Selection of the size of units in electrical energy generation is that the size should be selected such that the unit operates close to the load cure of the station.

Load curve decide the installed capacity of a power station. It is helpful in choosing the most economical size of the various generating units.

16. Which of the following expressions clearly indicates determination of the diversity factor in a power system ?

(a) $\frac{\text{Average demand}}{\text{Maximum demand of the whole system}}$

(b) $\frac{\text{Sum of Individual maximum demand}}{\text{Maximum demand of the whole system}}$

(c) $\frac{\text{Maximum demand}}{\text{Sum of individual maximum demand}}$

(d) $\frac{\text{Maximum demand of the whole system}}{\text{Sum of individual maximum demand}}$

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Diversity factor is defined as the ratio of the sum of the maximum demands of the various part of a system to the maximum demand of the whole system.

The diversity factor can be equal or greater than 1. If the value of the diversity factor is greater than 1 then it is a good diversity factor, and 1 represents a poor diversity factor.

17. The ratio of the area under the load curve to the total area under the rectangle in which it is contained gives the value of _____.

(a) utilization factor (b) diversity factor
(c) load factor (d) average demand

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The ratio of the area under the load curve to the total area under the rectangle in which it is contained gives the value of load factor.

$$\text{Load Factor} = \frac{\text{Average load}}{\text{Peak load}}$$

Load factor is always less than.

Chapter-6 TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER

i.Parameters & Performance of Transmission Lines

1. For an ideal short transmission line with zero voltage regulation, if receiving end voltage is 150 kV, then the sending end voltage will be:

(a) 150 kV (b) 200 kV
(c) 125 kV (d) 300 kV

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Given,

V.R. = 0

$V_R = 150kV$

$V_S = ?$

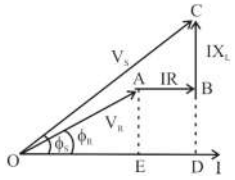
Formula-

$$V.R = \frac{V_S - V_R}{V_R}$$

$$0 = \frac{V_S - V_R}{V_R}$$

$$\boxed{V_S = V_R = 150kV}$$

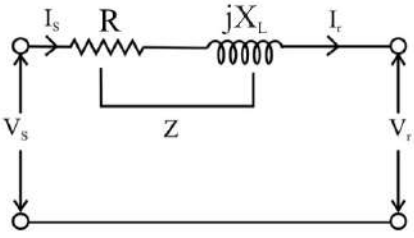
2. The figure shows the lagging load phasor representation of a transmission line, where, V_S, R, X_L ,V_R and I represent the sending end voltage, line resistance, line inductance, receiving end voltage and line current, respectively. Identify the transmission line which most suited for it.

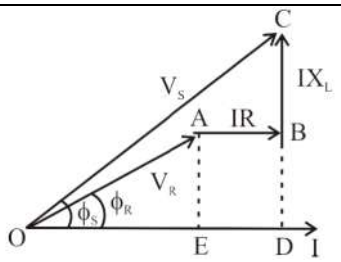


(a) 400 kV transmission line
(b) 10 kV transmission line
(c) 200 kV transmission line
(d) 100 kV transmission line

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given phasor diagram represents short transmission line





- In short transmission line length is 80km (for 50Hz)
- In short transmission line voltage is 0 to 20kV
- In short transmission line capacitance effect is neglected.

ii.Constructional Features of Transmission Lines

3. Identify the correct voltage range of medium transmission line.

(a) >1kV < 5 kV (b) >100 kV < 200 kV
(c) >20 kV<100 kV (d) >5 kV< 10 kV

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) :

Type of transmission line	Based on operating voltage	Classification based on length
Short line	20 kV	ℓ < 80 km
Medium line	20-100 kV	80 km < ℓ < 240 km
Long line	> 100 kV	ℓ > 240km

4. The height between the two supports of a transmission and distribution overhead line can be determined as:

(a) $\frac{1}{2}\times$ (Vertical distance between the lower height support point of the conductor and lowest point of the conductor)

(b) (Vertical distance between the lower height support point of the conductor and Lowest point of the conductor) + (Vertical distance between the higher height support point of the conductor and lowest point of the conductor)

(c) (Vertical distance between the higher height support point of the conductor and Lowest point of the conductor) – (Vertical distance between the lower height support point of the conductor and lowest point of the conductor)

(d) $\frac{1}{2}\times$ (Vertical distance between the higher height support point of the conductor and lowest point of the conductor

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : The height between the two supports of a transmission and distribution line can be determined as (vertical distance between the higher height support point of the conductor and lowest point of the conductor)–(Vertical distance between the lower height support point of the conductor and lowest point of the conductor).

5. Which of the following is NOT suitable for the overhead conductor of a transmission line?

(a) High specific gravity
(b) High tensile strength
(c) High electrical conductivity
(d) Lower cost

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : An overhead conductor of a transmission line should have following properties-

- High electrical conductivity
- High tensile strength in order to withstand mechanical stress.
- Relatively lower cost without compromising much of other properties.
- Low specific gravity.
- Lower weight per unit volume.

iii.Mechanical Design of Lines

6. The conductor of an overhead transmission line has cross-sectional area of 2 cm^2. If the specific gravity of the conductor material is 9.9 gm/cm^3 and wind pressure is 1.5 kg/m length. The effective weight per meter of length (kg/m) of the conductor will be ____.

(a) 5.48 kg/m (b) 2.48 kg/m
(c) 3.48 kg/m (d) 4.48 kg/m

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,

$A = 2cm^2$, wind pressure = 1.5kg/m length

Weight of conductor (W_c) = specific gravity of conductor material × cross sectional area of transmission line

$= 9.9\ gm/cm^3 \times 2cm^2$
$= 19.8\ gm/cm$
$= 1.98\ kg/m$

The effective weight per metre of length (kg/m)-

$$W_t = \sqrt{W_c^2 + W_w^2} = \sqrt{(1.98)^2 + (1.5)^2}$$

$$\boxed{W_t = 2.48 kg/m}$$

7. The bundled conductors can be formed from two or more stranded conductors, bundled together to increase the _____.

(a) Copper losses
(b) Current carrying capacity
(c) Line inductance
(d) Communication line interference

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

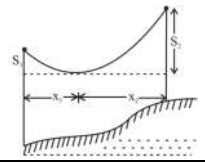
Ans. (b) : The bundled conductors can be formed from two or more stranded conductors bundled together to increases the current carrying capacity.

8. Which of the following is the correct interrelation between the variables x_1 and x_2 used in the expression to calculate the sag in a transmission conductor with different heights, where, variables x_1 and x_2 represent the horizontal distances of support at lower and higher levels from lowest point of the conductor, respectively?

(a) $x_1 = x_2$ (b) $x_1 >> x_2$
(c) $x_1 > x_2$ (d) $x_1 < x_2$

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : The correct interrelation between the verticals x_1 and x_2 used in the expression to calculate the sag in a transmission conductor with different height where variable x_1 and x_2 represent the horizontal distances of support at lower and higher levels from lowest point of the conductor is $x_1 < x_2$



9. If supports are at equal levels and tension in an overhead line is increased to two times, then—.

(a) Sag decreases to half of the previous value
(b) Sag also increases to two times
(c) Sag also increases to four times
(d) Sag becomes zero

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (a) : If supports are at equal levels-

$$\text{Sag (S)} = \frac{W\ell^2}{8T}$$

Where,

ℓ = length of the span
W = Weight per unit length of conductor
T = Tension in the conductor

$$S = \frac{W\ell^2}{8T}$$

$$\Rightarrow \quad \boxed{S \propto \frac{1}{T}}$$

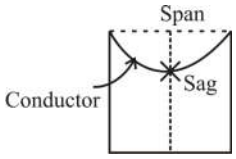
So, if supports are at equal levels and tension in an overhead line is increased to two times, then sag decreases to half of the previous value.

10. Select the INCORRECT statement for an overhead transmission line supported by supports at equal levels.

(a) Sag is inversely proportional to the tension of the conductor.
(b) Sag is inversely proportional to the height of the supporting tower.
(c) Sag is directly proportional to the weight per unit length of the conductor.
(d) Sag is directly proportional to the square of the length of the conductor span.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Sag is defined as the difference in level between points of supports and the lower point on the conductor



We know that,

$$S = \frac{WL^2}{8T}$$

Where, S is the sag of conductor
L = Length of span
W = Weight per unit length of the conductor
T = tension of conductor

- Sag is inversely proportional to the tension of the conductor.
- Sag is directly proportional to the weight per unit length of the conductor
- Sag is directly proportional to the square of the length of the conductor span.

Hence sag does not depend on height of the supporting tower.

11. A overhead transmission line is supported by supports at equal levels. If the length of the conductor span is increased by two times, the sag will ____. (Given, weight per unit length and tension in the conductor are constant.)

(a) decrease by four times
(b) increase by two times
(c) decrease by two times
(d) increase by four times

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : We know that

$$\text{Sag}(S) = \frac{\omega \ell^2}{8T}, \qquad \text{Sag}(S) \propto \ell^2$$

Given, length of conductor span $(\ell) = 2\ell$

then, $S \propto (2\ell)^2$

$S \propto 4\ell^2$

Then, the sag(S) will be increased by four times.

iv.Underground Cables

12. Which of the following is NOT a desirable criteria for an underground cable ?

(a) Proper insulation thickness should be taken care of in order to provide greater degree of safety
(b) Conductors should be used such that heating loss is minimum
(c) Conductors used in the cable should be stranded
(d) Mechanical protection is not required in any underground cable

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Mechanical protection is not required in any under ground cable as given in option is not a desirable criteria for an underground cable.

Desirable Criteria for an underground cable-

- Conductors used in the cable should be stranded.
- Proper insulation thickness should be taken care of in order to provide greater degree of safety.
- Conductors should be used such that heating loss is minimum.

13. Which of the following statements is accurate regarding wires and cables?

(a) Cables are made by stranding together many wires
(b) Wires and cables are never insulated
(c) Wires and cables are the same thing
(d) Wires are made by stranding together many cables

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Cables are made by stranding together many wires. Electrical wire consist of a single conductor and cable holds multiple wires inside them.

14. If the frequency of supply in a three core underground cable is doubled, the charging current will be .....

(a) four times (b) double
(c) half (d) Three times

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Charging current in three core underground cable-

$$I_C = 2\pi f V_{ph} (C_e + 3C_C)$$

$$\boxed{I_C \propto f}$$

if frequency is doubled then charging current doubled.

15. Find the most economical size of a single core cable working on a 100 kV single phase system and the maximum permissible stress in the dielectric is not to exceed $50\sqrt{2}$ kV/cm .

(a) 8 cm (b) 4 cm
(c) 0 cm (d) 10 cm

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given,

$$V = 100\text{kV}, \; E_{max} = 50\sqrt{2}\,\text{kV/cm}$$

For most economical size of the conductor-

$$E_{max} = \frac{2V_{max}}{d}$$

$$50\sqrt{2} = \frac{2 \times 100\sqrt{2}}{d} \qquad \left[\because V_m = \sqrt{2}V_{rms}\right]$$

$$\boxed{d = 4\text{cm}}$$

16. The cable rating suitable for connecting the load of 3 kW to a single phase supply of 230 V is ——.

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

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : The power rating,

$P = VI\cos\phi$

$3000 = 230 \times I \times 1$ [Let $\cos\phi = 1$]

$I = \frac{3000}{230} = 13.043A$

Therefore the cable rating suitable for connecting a load of 3kW to a single phase supply of 230V is 15A.

17. The method of creating uniform electrostatic stress in the dielectric of underground cables is known as _____ of cables.

(a) Armouring (b) Grading

(c) Jointing (d) Laying

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : The method of creating uniform electrostatic stress in the dielectric of underground cable is known as grading of cables.

The electrostatic stress in a single core cable has maximum value (g_{max}) at the conductor surface and decreases going towards sheath.

The method of equalizing the stress in the dielectric of the cable is known as grading of cable.

18. Which of the following is the outermost layer of an underground cable ?

(a) Serving (b) Armour

(c) Insulation (d) Sheath

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Serving is the outermost layer of an underground cable. Serving is the layer of fibrous materials like jute which protects armouring from atmospheric conditions.

Different layers of cables are-

(i) Conductor or core (ii) Insulation

(iii) Metallic sheath (iv) Bedding (v) Armouring

(vi) Serving

19. What is the charging currant per phase of a three-core underground cable connected to 22 kV, 50 Hz three phase supply ? Given that the capacitance of each phase to neutral is 18 μF. (Given the connection is star connected.)

(a) 71.82 A (b) 84.45

(c) 82.13 A (d) 50 A

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : We know that

$$\mathbf{I_C} = \frac{V_{ph}}{X_C} = \omega C V_{ph}$$

$$I_C = 2\pi f C V_{ph}$$

From question

$$V_{ph} = \frac{V_L}{\sqrt{3}} = \frac{22 \times 10^3}{\sqrt{3}} = 12701.70\,V$$

then,

$$I_C = 2 \times \pi \times 50 \times 18 \times 10^{-6} \times 12701.70$$

$$= 71.82\ A$$

v.Distribution System

20. A substation is a facility that transmits and distributes electricity. It serves as an intermediary between electricity plants and end users. Which of the following statements about substation is INCORRECT?

(a) Domestic consumers may also connect directly to the main transmission network

(b) All of the options

(c) Rotary converters are also used in railway substations

(d) At the point of interconnection between two distinct transmission voltages, transformers may be installed in a substation.

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : A substation is a facility that transmits and distributes electricity. It serves as an intermediary between electrically plants and end user.

The following statements about substation is correct-

(i) Domestic consumers may also connect directly to the main transmission network.

(ii) Rotary converters are also used in railway substations.

(iii) At the point of interconnection between two distinct transmission voltages, transformers may be installed in substation.

21. According to IS (Indian Standard) specification 1180-1964 for outdoor type distribution transformer, the tapings shall be provided on hv side in _____.

(a) 3 steps (b) 6 steps

(c) 5 steps (d) 2 steps

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : According to IS (Indian standard) specification 1180-1964 for outdoor type distribution transformer, the tapings shall be provided on hv side in 5 steps.

22. Which of the following CANNOT be caused due to excessive voltage drop in an electric distribution system ?

(a) Electric lights to burn dimly
(b) Electric lights to flicker
(c) Electric motors to run colder than normal
(d) Electric heaters to heat poorly

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Electric motors to run colder than normal cannot be caused due to excessive voltage drop in an electric distribution system.

23. The standard voltage between any two phases in three-phase four-wire secondary distribution system have _____.

(a) 33 kV (b) 400 V
(c) 230 V (d) 11 kV

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : The standard voltage between any two phases in three-phase four-wire secondary distribution system have near about 400 Volt and voltage between any line and the neutral conductor have near about 240 Volt.

24. In radial distribution system, separate feeder radiates from single substation and feeds the distributors at ____.

(a) one end only (b) two ends
(c) three ends (d) four ends

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : In radial distribution system separate feeder radiates from single substation and feeds the distributors at one end only. The main characteristic of radial distribution is that the power flow is only in one direction.

vi.Bus Bar and load Flow Analysis

25. What kind of metal does continuous bus bar wire typically consist of ?

(a) Iron
(b) Neither copper nor aluminium
(c) Plastic
(d) Copper or aluminium

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Busbars are solid metal bars used to carry current. Typically made from copper or aluminum, busbars are rigid and flat-wider than cables but up to 70% shorter in height. They can also carry more current that cables with the same cross sectional area.

vi.Electric Power System Management

26. Which of the following statements is/are correct regarding black liquor?

A) It retains more than 50% of the biomass energy of wood.
B) It is a non-toxic substance produced when wood is burned into paper.
C) Tall oil is an important by-product separated from black liquor by skimming.

(a) B and C (b) A and B
(c) Only C (d) A and C

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Regarding black liquor-
(i) It retains more than 50% of the biomass energy of wood.
(ii) Tall oil is an important by-product separated from black liquor by skimming.
(iii) It is a toxic substance produced when wood is burned into paper.

27. Which phase of the project management lifecycle often takes the longest to wrap up?

(a) Estimation (b) Execution
(c) Planning (d) Conceptualisation

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : Execution phase of the project management life cycle often takes the longest to wrap up.
The project management life cycle steps-
(1) Initiating
(2) Planning
(3) Execute and complete task
(4) Closed project.

Chapter-7 UTILIZATION OF ELECTRICAL ENERGY

i.Illumination

1. The wavelength of a sodium vapour lamp is.....

(a) 326 nm (b) 254 nm
(c) 589 nm (d) 673 nm

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : A sodium vapour lamp is a gas-discharge lamp that uses sodium in an excited state to produce light at characteristic wavelength near 589 nm.

2. Three-point lighting is usually employed in film lighting schemes. Which of the following does NOT form a part of the scheme?

(a) Key lighting (b) Back lighting
(c) Bounce lighting (d) Fill lighting

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Three-point lighting is usually employed in film lighting scheme. The following form a part of the scheme-
(i) Key lighting (ii) Back lighting (iii) Fill lighting

3. Which of the following lighting calculation methods is handy and quick?

(a) Flux method
(b) Lumen method
(c) Point by point method
(d) Watts per square metre method

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Watts per square metre lighting calculation methods is handy and quick.

Methods for calculating the illumination of light-
(i) Watt per square meter method
(ii) Lumen or light flux method
(iii) Point to point or inverse-square law method.

4. Choose the correct alternative regarding Neon Lamps.

(a) The neon lamp normally emits green colour.
(b) If helium gas is used instead of neon, a greenish red colour is obtained.
(c) The neon lamp consists of neon and argon gas.
(d) The power factor of the neon tube is higher.

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Neon lamp:
- It is a cold cathode lamp and consists of a glass bulb filled with neon and argon gas.
- In this lamp, two electrodes are kept close to each other so that less voltage is required for starting the ionization of neon gas (110V ac or 150V dc).
- On giving supply, the neon gas ionizes and emits lights which is reddish (orange-red) in color.

Application- Voltage tester, Night lamps, Indicator lamp, For advertisement purpose.

5. Which of the following lamps is well suited for street lightning in terms of high luminous efficiency?

(a) Fluorescent lamp
(b) Compact fluorescent lamp
(c) Sodium vapour lamp
(d) Incandescent lamp

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (c) : Sodium vapour lamp is well suited for street lighting in terms of high luminous efficiency.
Low-pressure sodium lamps are highly efficient electrical light sources, but their yellow light restricts applications to outdoor lighting such as a street lamp.

6. The candle power of a lamp placed normal to a working plane is 40 candle power. Find the distance if the illumination is 10 lux?

(a) 2.5 m (b) 2 m
(c) 3 m (d) 1.414 m

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : Given that,
Candle power = 40
Illumination (I) = 10 lux

$$\text{Candle power} = \frac{F\ell ux}{4\pi}$$

$$40 = \frac{F\ell ux}{4\pi}$$

$$\text{Flux} = 40 \times 4\pi$$

$$\text{Illumination (I)} = \frac{\text{Flux}}{\text{Area of the surface}}$$

$$10 = \frac{4\pi \times 40}{4\pi r^2}$$

$$r^2 = \frac{40}{10}$$

$$r^2 = 4$$

$$\boxed{r = 2m}$$

7. Select the light bulb that uses the least amount of energy while yet producing an adequate amount of light.

(a) Neon lamps (b) LED lamp
(c) Incandescent lamp (d) Fluorescent lamp

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : LED lamp that uses the least amount of energy while yet producing an adequate amount of light.
LED lamp efficiency is high because the lamp waste very little energy on heat.

8. Which of the following lamps are used in searchlights ?
(a) Neon lamps (b) Fluorescent lamps
(c) Sodium vapour lamp (d) Arc lamps
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Carbon arc lamps arc used in cinema projector, search light and flash camera because it produces a high intensity white light.

9. Which of the following options shows the correct proportion of helium and neon gases in the mixture for helium neon laser ?
(a) 10% of helium and 90% of neon
(b) 80% of helium and 20% of neon
(c) 20% of helium and 20% of neon
(d) 90% of helium and 10% of neon
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : The correct proportion of helium and neon gases in the mixture for helium neon laser are 90% of helium and 10% of a neon.

10. In electrical applications, the coil of an infrared lamp is made up of _____.
(a) copper (b) tungsten
(c) nichrome (d) iron
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : In electrical application, the coil of an infrared lamp is made up of tungesten.

11. In a metal filament bulb, the filament used as a heating coil is tungsten due to its _____.
(a) high melting point and low resistivity
(b) low melting point and high resistivity
(c) high melting point and high resistivity
(d) low melting point and low resistivity
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : In a metal filament bulb, the filament used as a heating coil is tungsten due to its high melting point and high resistivity, it does not burn at room temperature but the bulb glows at high temperature.

12. Which of the following lamps is suitable for highway lighting ?
(a) Neon lamp
(b) Fluorescent lamp
(c) Incandescent lamp
(d) Sodium vapour light
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Sodium vapour light lamp is suitable for highway lighting. Sodium vapour lamp is a gas-discharge lamp that uses sodium (Na) in exciting condition to generate light. These lamps are mostly used in street lights and industrial purposes.

13. Which of the following lamps is used for the determination of polarity of DC mains ?
(a) Sodium vapour lamp
(b) Carbon arc lamp
(c) Mercury vapour lamp
(d) Neon discharge lamp
SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Neon discharge lamp is used for the determination of polarity of DC mains. Neon discharge lamp is made of a discharge tube fitted with two electrodes. These electrodes are supplied with AC or DC supply. Neon gas is filled inside the tube when supply is given discharge takes place through neon gas that emits reddish light in the form of electromagnetic radiation.

ii.Electric Heating

14. Which of the following defines the use of a thermostat in an electric kettle?
(a) It is used to reduce the temperature in case of overheating of the heating element.
(b) It is used to compare the ambient temperature with the temperature inside the kettle.
(c) It is used to maintain the temperature inside the kettle.
(d) It is used to stop the flow of electricity through the heating element once the appropriate temperature is reached.
SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (d) : It is used to stop the flow of electricity through the heating element once the appropriate temperature is reached.
A thermostat is a regulating device component which senses the temperature of a physical system and performs actions so that the system temperature is maintained near a desired set point.

iii.Refrigeration and Cooling

15. A 2500 watts refrigerator works for 4 hours per day. Find the total unit of electricity used in 40 days
(a) 10 units (b) 40 units
(c) 400000 units (d) 400 units
SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Given,
$P = 2500$ watts
$t = 40 \times 4 = 160$ hours
$E = p \times t = 2500 \times 160$
$$E = \frac{400,000\,kW}{1000}$$
$E = 400$ unit

Chapter-8 ELECTRICAL AND ELECTRONIC ENGINEERING MATERIALS

1. In the application of electrical circuits, the nichrome that is used to make the heating element in an electric cooker has _____.

(a) 40% nickel and 60% chromium
(b) 80% nickel and 20% chromium
(c) 50% nickel and 50% chromium
(d) 20% nickel and 80% chromium

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : In the application of electrical circuits, the nichrome that is used to make the heating element in an electric cooker has 80% nickel and 20% chromium.

2. Which of the following overhead conductor material is preferred for the harmful gas (like ammonia) atmosphere?

(a) Aluminium (b) Galvanized steel
(c) Phosphor bronze (d) Cadmium copper

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (c) : Phosphor bronze overhead conductor materials is preferred for the harmful gas (like ammonia) atmosphere.

3. A permanent magnetic material has ..... retentivity.

(a) Zero (b) High
(c) Constant (d) Low

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (b) : A permanent magnetic material has high retentivity.

And permanent magnets should have high coercivity so that external magnetic fields in opposite directions can not easily demagnetize the magnet.

4. Which of the following is NOT a desirable property for the insulating materials used in an underground cable?

(a) High insulation resistance
(b) High dielectric strength
(c) Non-inflammable
(d) Hygroscopic

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Desirable property for insulating materials used in an underground cable-

(i) High insulating resistance
(ii) High dielectric strength
(iii) Non-inflammable.

- Hygroscopic substance is an ionic compounds can easily become hydrate by absorbing water molecules from water vapour in the air.

5. In the application of electrical and magnetic circuits, the heater element in an electric iron is manufactured by using——.

(a) Tungsten (b) Nichrome
(c) Iron (d) Copper

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : In the application of electrical and magnetic circuits, the heater element in an electrical iron is manufactured by using nichrome.

- Nichrome is an alloy of manganese 1.5%, Ni 75% to 78%, chromium 20% to 23% and a little percentage of Iron.
- The melting point of nichrome is 1400ºC with high resistance which makes this element best for use as a heating element.

6. In electrical applications, electric geyser coils are made up of a _____.

(a) low-inductance metal
(b) high-resistance metal
(c) high-inductance metal
(d) low-resistance metal

SSC JE 10.10.2023, Shift-II Paper-I (Pre)

Ans. (b) : In electrical applications, electric geyser coils are made up of a high resistance metal.

7. Which of the following is the application of soft magnetic materials?

(a) Electromagnets (b) Microphones
(c) Speakers (d) Permanent magnets

SSC JE 11.10.2023, Shift-III Paper-I (Pre)

Ans. (a) : Electromagnets are made from soft magnetic materials.

Properties of soft magnetic materials.
(i) High permeability
(ii) Slight coercive force
(iii) Low hysteresis loss
(iv) High saturation magnetism

8. Which of the following is a ferromagnetic material?

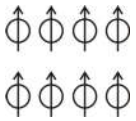
(a) Oxygen (b) Water
(c) Gold (d) Nickel

SSC JE 09.10.2023, Shift-III Paper-I (Pre)

Ans. (d) : Nickel is a ferromagnetic material.

Ferromagnetic materials exhibit parallel alignment of moments resulting in large net magnetization even in the absence of magnetic field.

Ex- Fe, Ni, Co



Parallel alignment