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Preface

This book has been written to meet the growing requirements of candidates appearing for State Engineering Service Examination, Junior Engineer, Public Sector Units, RRB-JE and Metro Exams. Though every candidate has ability to succeed but competitive environment, in-depth knowledge, quality guidance, time management and good source of study is required to achieve goals.

This book includes Multiple Choice Questions (MCQ Volume-II) which works as a mock exam practice for the reader. Questions of all the subject have been organized in systematic, concepts oriented and error less manner so that it become easy and interesting for even a beginner to understand. It is a very convenient book and must be solved by candidate aiming for competitive exams.

After solving this booklet students can feel encouraged and develop confidence to attempt each and every type of numerical as well as theoretical problems. Each problems explains solving approach so that at the end, so the reader is well equipped to be able to apply any type of problem solving requirement and distinctly choose one strategy or type from the other.

We hope this book will be proved an important tool to succeed in State Engineering Service Examination, Junior Engineer, Public Sector Units, RRB-JE and Metro Exams.

It is earnestly hoped that with the extensive additions and revisions, the present edition will facilitate the students not only in preparing themselves for competitive examinations but also in preparing for their regular examinations and prove more useful to the students than the earlier editions.

Even though, enough readings were given for correcting the error and printing mistakes, due to human tendency there could be some minor typos in the book. If any such typos found, they will be highly appreciated and incorporated in the next edition. Also, please provide your valuable suggestions at :engineers.academy.india@gmail.com

All the Best!

Engineers Academy Editorial Board

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UNIT-I

POWER SYSTEM

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CHAPTER 1

GENERATION OF ELECTRICAL POWER & ECONOMIC CONSIDERATION

OBJECTIVE QUESTIONS

1. The secondary sources of energy are

(a) Solar, wind and water

(b) Coal, oil and uranium

(c) Either (a) or (b)

(d) Neither (a) or (b)

2. The draught which a chimney produces is called

(a) Induced draught (b) Natural draught

(c) Forced draught (d) Balanced draught

3. The draught in locomotive boilers is produced by

(a) Forced fan

(b) Chimney

(c) Steam jet

(d) Only motion of locomotive

4. Caking coals are those which

(a) Burn completely

(b) Burn freely

(c) Do not form ash

(d) Form lumps or masses of coke

5. Blowing down of boiler water is the process

(a) To reduce the boiler pressure

(b) To increase the steam temperature

(c) To control the solid concentration in the boiler water by removing some of the concentrated saline water

(d) None of the above

6. The blades of the gas turbine rotor are made of

(a) Carbon steel

(b) Stainless steel

(c) High alloy steel

(d) High nickel alloy (Nimic 80)

7. Fission chain reaction is possible when

(a) Fission produces the same number of neutrons which are absorbed

(b) Fission produces more neutrons than are absorbed

(c) Fission produces less neutrons than are absorbed

(d) None of the above

8. A consumer has to pay lesser fixed charges in

(a) Flat rate tariff

(b) Two part tariff

(c) Maximum demand tariff

(d) None of the above

9. In Hopkinson demand rate or two part tariff the demand rate or fixed charges are

(a) Dependent upon the energy consumed

(b) Dependent upon the maximum demand of the consumer

(c) Both (a) and (b)

(d) None of the above

10. In a load-duration curve for an integrated power system the uppermost crest represents the energy contributed by

(a) Base power station

(b) Major thermal station

(c) Peaking hydro or gas turbine stations

(d) Non-conventional power stations

11. The voltage of a single solar cell is

(a) 0.2 V (b) 0.5 V

(c) 1.0 V (d) 2.0 V

12. Load curve is useful in deciding the

(a) Operating schedule of generating units

(b) Sizes of generating units

(c) Total installed capacity of the plant

(d) All of the above

13. Annual operating expenditure of a power plant consists of

(a) Fixed charges

(b) Semi-fixed charges

(c) Running charges

(d) All of the above

14. Direct conversion of heat into electric power is possible through

(a) Fuel cell

(b) Batteries

(c) Thermionic converter

(d) All of the above

15. A pilot exciter is provided on generators for which of the following reasons?

(a) To excite the poles of main exciter

(b) To provide requisite starting torque to main exciter

(c) To provide requisite starting torque to generator

(d) None of the above

16. The maximum demand of a consumer is 2 kW and his daily energy consumption is 20 units. His load factor is

(a) 10% (b) 41.6%

(c) 50% (d) None of the above

17. The economizer, a component of steam power plants, is a heat-exchanger utilising the waste heat of

(a) Bleed-steam to heat the feed water

(b) Flue-gas to heat the feed water

(c) Flue-gas to heat the air going into the boiler

(d) Flue-gas to heat the pulverised coal

18. Match List-I (Power plant) with List-II (Application) and select the correct answer using the codes given below

	List-I		**List-II**
A.	Nuclear	**1.**	Base load
B.	Diesel	**2.**	Stand by
C.	Gas turbine	**3.**	Base load or peak load
D.	Hydro	**4.**	Peak load

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

19. Match List-I (Pressure head) with List-II (Type of turbine) and select the correct answer using the codes given below the lists

	List-I		**List-II**
A.	Low head	**1.**	Kaplan
B.	Medium head	**2.**	Francis
C.	High head	**3.**	Pelton

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

20. The instantaneous power taken by a balanced three-phase load supplied from a balanced three phase source is

(a) Zero

(b) A constant value

(c) A pulsating function with a non-zero average

(d) Alternating with a zero average

21. To increase power transfer capability of a long transmission line, we should

(a) Increase line resistance

(b) Increase transmission voltage

(c) Decrease line reactance

(d) Both (b) & (c)

[DMRC JE - 2016]

22. The moderator is used in nuclear power plant to

(a) prevent the reactor from harmful radiation

(b) increase the speed of neutron

(c) decrease the speed of neutron

(d) coolent

[LMRC JE - 2015]

23. Lignite, bituminous and anthracite are different ranks of

(a) Nuclear fuel (b) Coal

(c) Biogas (d) Natural gas

[TNPSC AE - 2018]

24. In a nuclear reactor, heavy water can be ideally used as

(a) Biological shield (b) Moderator

(c) Control rods (d) All of the above

25. Value of Power factor lies in between

(a) 0 and 1 (b) 0 and 10

(c) 10 and 100 (d) 10 and 1000

26. Which of the following is a device capable of supplying electrical energy?

(a) Microwave (b) Radio transmitter

(c) Solar cell (d) None of these

27. Large turbo-generators are usually driven by _____.

(a) Coal turbine (b) Steam turbine

(c) Diesel turbine (d) Water turbine

[UPPCL JE - 2014]

28. What is the maximum possible output of a solar array?

(a) 500 W/m^2 (b) 250 W/m^2

(c) 500 kW/m^2 (d) 250 mW/m^2

[DSSSB JE - 2014]

29. If maximum load of generating station and the rated plant capacity are equal then

(a) Load factor is 1

(b) Capacity factor is 1

(c) Load factor and capacity factor are equal

(d) Utilization factor is poor.

[UPPCL JE - 2014]

30. Which of the following expressions depicts the Utilization Factor?

(a) Ratio of maximum generator demand to the generator capacity.

(b) Ratio of actual energy produced to the generator capacity.

(c) Ratio of generator capacity to maximum generation demand.

(d) Ratio of generator capacity to actual energy produced.

[UPPCL JE - 2014]

31. In a star connected balanced circuit the phase difference between the line voltage V_{RY} and the phase voltage V_{RN} is equal to

(a) $30° - \phi$ (b) $60°$

(c) $120°$ (d) $30°$

[NMRC JE - 2017]

32. The following generating station has the minimum running cost

(a) Diesel power station

(b) Nuclear power station

(c) Hydroelectric power station

(d) Thermal power station

[NMRC JE - 2017]

33. The normal phase sequence of a 3 phase AC supply is

(a) RBY (b) RYB

(c) BRY (d) YBR

[NMRC JE - 2017]

500. ***Ans. (c)***

In substations, the breaker maintenance facility is provided in the main and transfer bus scheme.

501. ***Ans. (b)***

Let us assume A and B are two substations which are apart of 8 km.

The potential of $P - 575 - I_A(0.04x)$

$$= 590 - (600 - I_A)(0.04)(8 - x)$$

$$x = \frac{1}{24}(177 - 0.32I_A)$$

$$I_A = \frac{177 - 24x}{0.32}$$

$$V_P = 575 - I_A(0.04x)$$

$$= 575 - \left(\frac{177 - 24x}{0.32}\right)(0.04x)$$

$$= 575 - 22.01x - 3x^2$$

For V_P to be minimum,

$$\frac{dV_P}{dx} = -22.01 - 6x = 0$$

$$x = \frac{22.01}{6} = 3.67 \text{ km}$$

502. ***Ans. (b)***

503. ***Ans. (a)***

β = Line impedance angle

$\delta = 30^\circ$

$\alpha = 0^\circ$

$A = D = 1.0$

($\because$ it is short line model)

$$P_{sending} = \left|\frac{D}{B}\right||V_S|^2 \cos(\beta-\alpha) - \frac{|V_S||V_r|}{|B|}\cos(\beta+\delta)$$

$$= \left|\frac{1.0}{5}\right| 100^2 \cos(90-0) - \frac{100 \times 100}{|5|}\cos(90+30)$$

$$= 1000 \text{ W}$$

$$Q_{sending} = \left|\frac{D}{B}\right||V_S|^2 \sin(\beta-\alpha) - \frac{|V_S||V_r|}{|B|}\sin(\beta+\delta)$$

$$= \left|\frac{1.0}{5}\right| 100^2 \sin(90-0) - \frac{100 \times 100}{|5|}\sin(90+30)$$

$$= 268 \text{ VAR}$$

504. ***Ans. (c)***

Power is always transferred from high voltage system to low voltage system.

505. ***Ans. (d)***

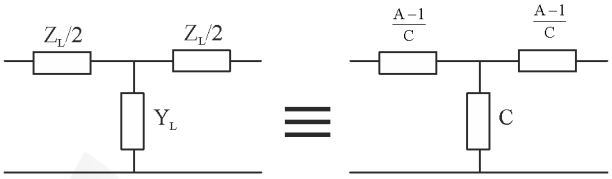
Number of strands

$$= 3x^2 - 3x + 1$$

Where x = Layer number

$\Rightarrow 3(3)^2 - 3 \times 3 + 1 = 19$

506. ***Ans. (c)***



507. ***Ans. (c)***

The shape of the sag curve is 'catenary' If there in no catenary in options choose parabola.

508. ***Ans. (c)***

Since the mutual capacity of each disc is same and the current through the top most units is minimum, the voltage drop across that unit will be minimum. As we go down the unit towards the power conductor the current goes on increasing being the maximum in the lowest unit the voltage drop is maximum there.

509. ***Ans. (b)***

Skin depth, $\delta \propto \sqrt{\frac{1}{f}}$

As frequency increases skin depth decreases. Hence skin effect increases finally resistance of the conductor increases.

510. ***Ans. (c)***

511. ***Ans. (d)***

Characteristic impedance

$$(Z_c) = \sqrt{\frac{L}{C}} = \sqrt{\frac{0.1}{0.001}}$$

$$(Z_c) = 10\ \Omega$$

512. ***Ans. (c)***

Percentage regulation

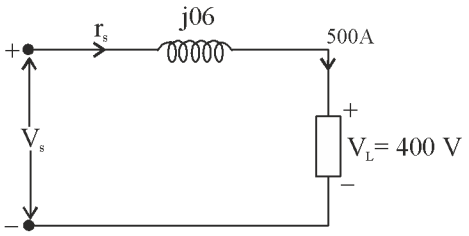
$$= \%R \cos\phi \pm \% X \sin\phi$$

'+' for lag p.f '–'

For load p.f $= 3 \times 0.8 - 5 \times 0.6$

$$= 2.4 - 3 = -0.6$$

513. ***Ans. (b)***



Load resistance

$$(R_L) = \frac{400}{500} = 0.8\ \Omega$$

Sending end

$$\text{p.f.} = \frac{R_L}{Z} = \frac{0.8}{0.8 + j0.6}$$

$$= 0.8 \text{ p.f. lag}$$

514. ***Ans. (c)***

The electrical power transmission network is both symmetrical (A = D) and reciprocal (AD – BC = 1).

515. ***Ans. (d)***

$$C_{ph} = 2C_{ab} = 2(1\ \mu F) = 2\ \mu F$$

516. ***Ans. (a)***

517. ***Ans. (d)***

$$L_{AB} = 4 \times 10^{-7} \ln\left(\frac{d}{r'}\right)$$

$$= 4 \times 10^{-7} \ln\left(\frac{150}{0.7788 \times 0.5}\right)$$

$$L_{AB} = 23.8 \text{ mA}$$

518. ***Ans. (a)***

$$\text{sag}(S) = \frac{WL^2}{8T}$$

Where,

W = Weight of the conductor/meter

L = Span

T = Tension in the line

W = 0.7 kg/m

$$\text{Maximum sag} = \frac{(0.7) \times (220)^2}{8 \times 1400}$$

$$= 3.025 \text{ m}$$

519. ***Ans. (a)***

String efficiency (η_s)

$$= \frac{\text{Sum of the voltages across each disc}}{\text{m} \times \text{Voltage across bottom most disc}} \times 100$$

$$(\eta_s) = \frac{38\text{kV}}{4 \times 12\text{kV}} \times 100$$

$$= \frac{38}{48} \times 100 = 79.16\%$$

520. ***Ans. (b)***

521. ***Ans. (c)***

In order to get one full wave variation of voltage (or) current on the line, the length of the line for 50 Hz supply will be given by

$$f\lambda = \upsilon$$

Where f = Supply frequency

λ = Wavelength

i.e, The length of the line.

υ = velocity of wave

$= 3 \times 10^8$ m/sec.

$\because$ $$\lambda = \frac{\upsilon}{f} = \frac{3 \times 10^8}{50}$$

$= 6000$ km

For 6000 km wave length, the line with more than 160 km length is treated as long line.

For 500 Hz wave

$$\lambda = \frac{3 \times 10^8}{500} = 600 \text{ km}$$

Hence with 500 Hz supply, a line with more than 16 km length is treated as long line, where line parameters are distributed.

522. ***Ans. (a)***

523. ***Ans. (a)***

Load compensation in power systems is a process to maintain better voltage profile.

524. ***Ans. (c)***

The two components of the traveling wave are given by $f\left(t - \frac{x}{V}\right)$ and $f\left(t + \frac{x}{V}\right)$.

The sum of the two Quantities is total voltage at time 't'.

525. ***Ans. (b)***

$$\eta = \frac{2+K}{2(1+K)} \times 100$$

$$= \frac{2+1}{2(1+1)} \times 100$$

$$= \frac{3}{4} \times 100 = 75\%$$

526. ***Ans. (a)***

527. ***Ans. (b)***

528. ***Ans. (d)***

529. ***Ans. (b)***

530. ***Ans. (b)***

531. ***Ans. (b)***

532. ***Ans. (c)***

533. ***Ans. (b)***

The critical voltage for the formation of corona will be increased by using bundled conductors.

534. ***Ans. (a)***

The most effect of wind pressure is more predominant on supporting towers as compare to other equipment of transmission line.

535. ***Ans. (b)***

536. ***Ans. (d)***

The main advantage of cable in over head distribution line it used in congested areas.

537. ***Ans. (c)***

538. ***Ans. (a)***

The R.C.C. pole is used for service lines.

539. ***Ans. (b)***

The corss arm is fixed on the pole to fix the insulator.

540. ***Ans. (d)***

If a cable is to cross a road, it should be laid in pipes or conduits.

541. ***Ans. (b)***

In three phase star connection.

Line voltage = $\sqrt{3}$ phase voltage

Line current = Phase current.

542. ***Ans. (a)***

543. ***Ans. (a)***

$$P_{max} = \frac{V_s^2}{Z_s}$$

After 60% of series capacitor compensation then the impedance

$$Z_{sl} = Z_s(1 - k) = 0.4Z_s$$

$$P_{max} = \frac{V_s^2}{Z_s} = \frac{V_s^2}{0.4Zs} = \frac{P_{max}}{0.4}$$

544. ***Ans. (d)***

545. ***Ans. (c)***

Active power (p) = VI cosϕ

$$\cos\phi = \frac{P}{VI}$$

The unit of Active power = KW and VI is apparent power it's unit KVA.

then

$$\text{power factor } (\cos\phi) = \frac{KW}{KVA}$$

Power factor is a diamensionaless number,

546. ***Ans. (a)***

Sparking occurs when a load is switched off because the circuit has high inductance.

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21. ***Ans. (d)***

In Gauss Seidal load flow method a reliable convergence occurs but the time taken for convergence will be high.

22. ***Ans. (d)***

A suitable value of α for a particular system can be obtained by running trail load flows. $\alpha = 1.6$ is general recommended value for most of the systems.

23. ***Ans. (c)***

In Y bus formation $Y_{ij} = -y_{ij}$

24. ***Ans. (d)***

In Newton-Raphson method, the number of iterations are least but the time taken per iteration is more.

25. ***Ans. (b)***

26. ***Ans. (b)***

27. ***Ans. (d)***

The time taken to perform one iteration of the computation is relatively smaller in case of GS method as compared to NR method but the number of iterations required by GS method for a particular system are greater as compared to NR method. In case of NR method the number of iterations is more or less independent of the size of the system and vary 3 to 5 iterations. The convergence characteristics of NR method are not affected by the selection of a slack bus where as that of GS method is some times very seriously affected and the selection of a particular bus may result in poor convergence.

28. ***Ans. (b)***

In a power system network, the load is represented as constant power in load flow study, where as constant impedance in stability study.

29. ***Ans. (b)***

30. ***Ans. (a)***

Number of buses (n) = 20

The size of Jacobian matrix

$$= (2n - 2) \times (2n - 2)$$
$$= (40 - 2) \times (40 - 2)$$
$$= 38 \times 38$$

31. ***Ans. (c)***

32. ***Ans. (d)***

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