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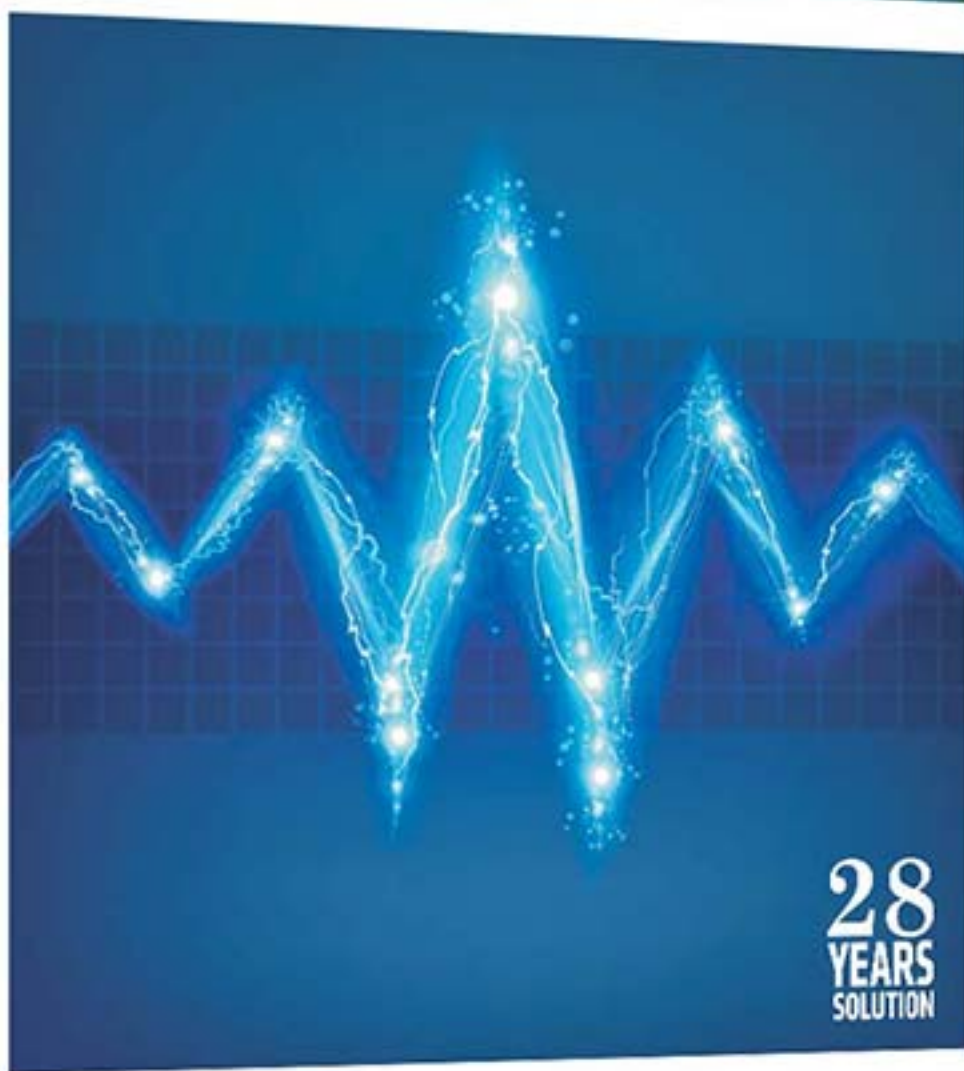
ELECTRICAL  
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# GATE

2019

ELECTRICAL ENGINEERING GATE-2019

28  
YEARS  
SOLUTION



28  
YEARS  
SOLUTION

# **GATE SOLUTIONS**

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**Second Edition** : 2017

**Third Edition** : 2018

# PREFACE

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It is an immense pleasure to present topic wise previous years solved paper of GATE Exam. This booklet has come out after long observation and detailed interaction with the students preparing for GATE exam and includes detailed explanation to all questions. The approach has been to provide explanation in such a way that just by going through the solutions, students will be able to understand the basic concepts and will apply these concepts in solving other questions that might be asked in future exams.

GATE exam now a days has become more important because it not only opens the door for higher education in institutes like IIT, IISc, NIT's but also many of the PSUs have started inducting students on the basis of GATE score. In PSU's, which are not inducting through GATE route, the questions in their exams are asked from GATE previous year papers. Thus, availability of authentic solutions to the students is the need of the day. Towards this end this booklet becomes indispensable.

I am thankful to IES master team without whose support, I don't think, this book could have been flawlessly produced.

Every care has been taken to bring an error free book. However comments for future improvement are most welcome.

**Mr. Kanchan Kumar Thakur**  
Director Ex-IES

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# Power Systems

Unit

1

## Syllabus

*Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss Seidel and Newton-Raphson load flow methods, Voltage and frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.*

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# Generating Power Stations and Per Unit System

## 1 – Mark

1. A 500 MVA, 11 KV synchronous generator has 0.2 p.u. synchronous reactance. The p.u. synchronous reactance on the base values of 100 MVA and 22 KV is
  - (a) 0.16
  - (b) 0.01
  - (c) 4.0
  - (d) 0.25 [GATE-1991]
2. In order to have a lower cost of electrical energy generation
  - (a) The load factor and diversity factor should be low
  - (b) The load factor should be low but diversity factor should be high
  - (c) The load factor should be high but diversity factor should be low
  - (d) The load factor and diversity factor should be high. [GATE-1995]
3. Which material is used in controlling chain reaction in a nuclear reactor?
  - (a) Thorium
  - (b) Heavy water
  - (c) Boron
  - (d) Beryllium [GATE-1996]
4. In a thermal power plant, the feed water coming to the economiser is heated using
  - (a) H.P. Steam
  - (b) L.P. Steam
  - (c) Direct heat in the furnace
  - (d) Flue gases [GATE-2000]
5. The rated voltage of a 3-phase power system is given as
  - (a) rms phase voltage
  - (b) peak phase voltage
  - (c) rms line to line voltage
  - (d) peak line to line voltage. [GATE-2004]
6. In thermal power plants, the pressure in the working fluid cycle is developed by
  - (a) condenser
  - (b) super heater
  - (c) feed water pump
  - (d) turbine [GATE-2004]
7. For harnessing low variable waterheads, the suitable hydraulic turbine with high percentage of reaction and runner adjustable vanes is
  - (a) Kaplan
  - (b) Francis
  - (c) Pelton
  - (d) Impeller [GATE-2004]
8. Out of the following plant categories :
  - (i) Nuclear
  - (ii) Run-off-river
  - (iii) Pump Storage
  - (iv) Diesel
 The base load power plants are
  - (a) (i) and (ii)
  - (b) (ii) and (iii)
  - (c) (i), (ii) and (iv)
  - (d) (i), (iii) and (iv) [GATE-2009]
9. A three phase star-connected load is drawing power at a voltage of 0.9 pu and 0.8 power factor lagging. The three phase base power and base current are 100 MVA and 437.38A respectively. The line-to-line load voltage in kV is \_\_\_\_\_. [GATE-2014]
10. Base load power plants are
 

P: wind farms  
Q: run-off-river plants  
R: nuclear power plants  
S: diesel power plants

 Choose the correct answer :
  - (a) P, Q and S only
  - (b) P, R and S only
  - (c) P, Q and R only
  - (d) Q and R only [GATE-2015]



## ANSWER KEY

## :: 1 MARK ::

1. (b)
2. (d)
3. (c)
4. (d)
5. (c)

6. (c)
7. (a)
8. (a)
9. (118.8)
10. (d)

## :: 2 MARKS ::

1. (0.125)
2. (c)
3. (b)
4. (d)
5. (d)

6. (b)
7. (b)

SOLUTION... 

## 1 – Mark

Sol-1: (b)

$$\begin{aligned} Z(\text{p.u.})_{\text{new}} &= Z(\text{p.u.})_{\text{old}} \times \left( \frac{kV_{\text{old}}}{kV_{\text{new}}} \right)^2 \times \left( \frac{MVA_{\text{new}}}{MVA_{\text{old}}} \right) \\ &= 0.2 \times \left( \frac{11}{22} \right)^2 \times \frac{100}{500} \\ &= \frac{0.2}{20} = 0.01 \end{aligned}$$

Sol-2: (d)

$$\text{Load factor} = \frac{\text{Average load}}{\text{Peak load}}$$

The cost of production depends upon two factors-fixed and variable cost. High load factor means fixed costs are spread over more kWh of output.

$$\text{Fixed cost per kWh} (\downarrow) = \frac{\text{Fixed Cost}}{\text{Generated energy} (\uparrow)}$$

$$\text{Group diversity factor} = \frac{\text{Sum of individual maximum demand}}{\text{Maximum demand of the group}}$$

A large diversity factor has the effect of reducing maximum demand on the plant. So lesser plant capacity is required. Thus, the capital investment on the plant is reduced, and the cost of generation is also reduced.

Sol-3: (c)

- Control rods are used to control the chain reaction in a nuclear reactor. The control

rods are made up of materials having high absorption cross section. Such materials are Boron, Hafnium and Cadmium.

- Thorium is used as a fuel in nuclear power plant.
- Heavy water is used as a moderator to slow down neutrons in a nuclear reactor, so that they are more likely to react with fissile material.
- Beryllium has low thermal neutron absorption cross section, hence it is used as a reflector in nuclear reactors to prevent neutrons from escaping.

Sol-4: (d)

Flue gases coming out of the boilers carry lot of heat. An economiser extracts a part of this heat from the flue gases and uses it for heating feed water.

Sol-5: (c)

The rated voltage of a 3-phase power system is always rms line to line voltage.

Sol-6: (c)

- In a thermal power plant, the feed water pump is used to pump feed water into a steam boiler. The feed water pump is used to generate sufficient pressure, so that the steam pressure developed by the boiler can be overcome.
- Condenser is used to condense the exhaust stream from a steam turbine to obtain maximum efficiency.
- Superheater converts wet steam to

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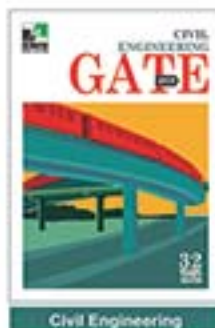
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