



ESE 2020

PRELIMINARY EXAMINATION



ELECTRICAL ENGINEERING

**ESE TOPICWISE OBJECTIVE
SOLVED PAPER-II**

ESE TOPICWISE OBJECTIVE SOLVED PAPER - II
ELECTRICAL ENGINEERING



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UPSC Engineering Service Examination 2020

ELECTRICAL ENGINEERING
ESE TOPICWISE OBJECTIVE SOLVED
PAPER-II

1992-2019



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PREFACE

Engineering Services Examination is the gateway to an immensely satisfying job in the engineering sector of India that offers multi-faceted exposure. The exposure to challenges and opportunities of leading the diverse field of engineering has been the main reason behind engineering students opting for Engineering Services as compared to other career options. To facilitate selection into these services, availability of arithmetic solution to previous years' paper is the need of the day.

It is an immense pleasure to present previous years' topic-wise objective solved papers of Engineering Services Examination (ESE). This book is an outcome of regular and detailed interaction with the students preparing for ESE every year. It includes solutions along with detailed explanation to all questions. The prime objective of bringing out this book is to provide explanation to each question in such a manner that just by going through the solutions, students will be able to understand the basic concepts and have the capability to apply these concepts in solving other questions that might be asked in future exams. Towards the end, this book becomes indispensable for every ESE aspiring candidate.

IES Master Publication
New Delhi

Note: Direction of all **Assertion Reasoning (A–R)** type of questions covered in this booklet is as follows:

DIRECTIONS:

The following four items consist of two statements, one labelled as '**Assertion A**' and the other labelled as '**Reason R**'. You are to examine these two statements carefully and select the answer to these two statements carefully and select the answer to these items using the codes given below:

- (a) Both A and R are individually true and R is the correct explanation of A
- (b) Both A and R are individually true but R is not the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true.

Note: Direction of all **Statement-I** and **Statement-II** type of questions covered in this booklet is as follows:

DIRECTION:

Following items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the code given below:

- (a) Both Statement : (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
- (b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).
- (c) Statement (I) is true but Statement (II) is false
- (d) Statement (I) is false but Statement (II) is true.

CONTENT

1. Electrical Machines and Power Transformers	01 – 196
2. Power Systems	197– 342
3. Analog Electronics	343 – 436
4. Digital Electronics	437 – 484
5. Microprocessor	485 – 540
6. Communication System	541 – 602
7. Power Electronics	603 – 678
8. System and Signal Processing	679 – 684



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UNIT-1

ELECTRICAL MACHINES AND POWER TRANSFORMERS

SYLLABUS

Magnetic Circuits-Analysis and Design of Power transformers. Construction and testing. Equivalent circuits. Losses and efficiency. Regulation. Auto-transformer, 3-phase transformer. Parallel operation.

Basic concepts in rotating machines. EMF, torque, basic machine types. Construction and operation, leakage losses and efficiency.

D.C. Machines. Construction, Excitation methods. Circuit models. Armature reaction and commutation. Characteristics and performance analysis. Generators and motors. Starting and speed control. Testing, Losses and efficiency.

Synchronous Machines. Construction. Circuit model. Operating characteristics and performance analysis. Synchronous reactance. Efficiency. Voltage regulation. Salient-pole machine, Parallel operation. Hunting. Short circuit transients.

Induction Machines. Construction. Principle of operation. Rotating fields. Characteristics and performance analysis. Determination of circuit model. Circle diagram. Starting and speed control.

Fractional KW motors. Single-phase synchronous and induction motors.

CONTENTS

Chapter No.	Topic	Page No.
1.	Transformers	01 – 49
2.	Basic Concepts of Rotating Electrical Machines	50 – 56
3.	DC Machines	57 – 105
4.	Induction Machines and Single Phase Motors	106 – 150
5.	Synchronous Machines	151 – 196

1

TRANSFORMERS

IES-1992

1. The desirable properties of transformer core material are
 - (a) low permeability and low hysteresis loss
 - (b) high permeability and high hysteresis loss
 - (c) high permeability and low hysteresis loss
 - (d) low permeability and high hysteresis loss
2. Which of the following acts as a protection against high voltage surges due to lightning and switching?
 - (a) Breather
 - (b) Conservator
 - (c) Horn gaps
 - (d) Thermal overload relays
3. The efficiency of two identical transformers under load conditions can be determined by
 - (a) back to back test
 - (b) open circuit test
 - (c) short circuit test
 - (d) any of the above
4. For an ideal transformer the windings should have
 - (a) maximum resistance on primary side and least resistance on secondary side
 - (b) least resistance on primary and secondary side
 - (c) equal resistance on primary and secondary side
 - (d) no ohmic resistance on either side
5. Two single phase 100 kVA transformers, each having different leakage impedance are connected in parallel. When a load of 150 kVA at 0.8 p.f. lagging is applied
 - (a) both transformer will operate at power factor more than 0.8 lagging
 - (b) both transformer will operate at power factor less than 0.8 lagging
 - (c) one of the transformers will operate at p.f. more than 0.8 lagging and other will operate at p.f. less than 0.8 lagging
 - (d) both transformers will operate at identical power factors
6. Scott connections are used for
 - (a) single phase to three phase transformation
 - (b) three phase to single phase transformation
 - (c) three phase to two phase transformation
 - (d) any of the above
7. Two single phase transformers with equal turns have impedance of $(0.5 + j0.3)$ ohms and $(0.6 + j1)$ ohms with respect to the secondary. If they operate in parallel, how will they share a load of 100 kW at 0.8 p.f. lagging?
 - (a) 50 kW, 50 kW
 - (b) 62 kW, 38 kW
 - (c) 78.2 kW, 21.8 kW
 - (d) 85.5 kW, 14.5 kW
8. The losses on a transformer are
 - I. Copper losses
 - II. Eddy current losses
 - III. Hysteresis lossesThe constant power loss of a transformer loss is given by
 - (a) I only
 - (b) I and II only
 - (c) II and III only
 - (d) I, II and III
9. Which of the following will improve the mutual coupling between primary and secondary circuits?
 - (a) Transformer oil of high break down voltage
 - (b) High reluctance magnetic core
 - (c) Winding material of high resistivity
 - (d) Low reluctance magnetic core

10. The secondary of a current transformer under operating conditions is short-circuited to avoid
- break in primary winding
 - insulation break-down
 - core saturation and high voltage induction
 - high voltage surge
11. The inductive reactance of a transformer depends on
- electromotive force
 - magneto motive force
 - magnetic flux
 - leakage flux
12. Which of the following connection of transformer will give the highest secondary voltage?
- Delta primary, delta secondary
 - Delta primary, star secondary
 - Star primary, star secondary
 - Star primary, delta secondary
13. While performing the open-circuit and short-circuit tests on a transformer to determine its parameters, the status of the low voltage (L.V) and high voltage (H.V) winding will be such that
- in O.C., L.V. is open and in S.C., H.V. is shorted
 - in O.C., H.V. is open and in S.C., L.V. is shorted
 - in O.C., L.V. is open and in S.C., L.V. is shorted
 - in O.C., H.V. is open and in S.C., H.V. is shorted

IES-1993

13. In a transformer, if the iron losses and copper losses are 40.5 kW and 50 kW respectively, then at what fraction of load will the efficiency be maximum?
- 0.8
 - 0.57
 - 0.70
 - 0.9
14. Can a 50Hz transformer be used as 25Hz, if the input voltage is maintained constant at the rated value corresponding to 50Hz?
- Yes since the voltage is constant, current levels will not change
 - No, flux will be doubled which will drive the core to excessive saturation
 - No, owing to decreased reactance of transformer, input current will be doubled at load
 - Yes, at constant voltage, insulation will not be overstressed
15. Short-circuit test is performed on a transformer with a certain impressed voltage at rated frequency. If the short-circuit test is now performed with the same magnitude impressed voltage, but at a frequency higher than the rated frequency, then

IES-1994

17. A 2kVA transformer has iron loss of 150 watts and full-load copper loss of 250 watts. The maximum efficiency of the transformer would occur when the total loss is
- 500 W
 - 400 W
 - 300 W
 - 275 W
18. If the frequency of input voltage of a transformer is increased keeping the magnitude of voltage unchanged, then
- both hysteresis loss and eddy current loss in the core will increase
 - hysteresis loss will increase but eddy current loss in the core will decrease
 - hysteresis loss will decrease but eddy current loss will increase
 - hysteresis loss will decrease but eddy current loss will remain unchanged.
19. The voltage regulation of a transformer at full load and 0.8 power factor lagging is 2.5%. The voltage regulation at full load 0.8 power factor leading will be
- 2.5%
 - zero
 - 0.9%
 - 2.5%

IES-2019

187. Consider the following statements regarding parallel connection of 3-phase transformers:

1. The secondaries of all transformers must have the same phase sequence.
2. The phase displacement between primary and secondary line voltages must be the same for all transformers which are to be operated in parallel.
3. The primaries of all transformers must have the same magnitude of line voltage.

Which of the above statements are correct?

- (a) 1, 2 and 3 (b) 1 and 3 only

- (c) 1 and 2 only (d) 2 and 3 only

188. A 500 kVA transformer has an efficiency of 95% at full load and also at 60% of full load, both at upf. The efficiency η of the transformer at $\frac{3}{4}$ th full load will be nearly

- (a) 98% (b) 95%
(c) 92% (d) 87%

189. A single-phase transformer is rated 110/440 V, 2.5 kVA. Leakage reactance measured from the low-tension side is 0.06Ω . The per unit leakage reactance will be

- (a) 0.0062/unit (b) 0.0124/unit
(c) 0.0496/unit (d) 0.1983/unit

ANSWER KEY

1. (c)	17. (c)	33. (b)	49. (b)	65. (a)
2. (c)	18. (d)	34. (a)	50. (d)	66. (d)
3. (a)	19. (c)	35. (c)	51. (c)	67. (b)
4. (d)	20. (b)	36. (c)	52. (b)	68. (d)
5. (c)	21. (a)	37. (d)	53. (a)	69. (a)
6. (c)	22. (d)	38. (c)	54. (d)	70. (a)
7. (c)	23. (b)	39. (a)	55. (a)	71. (a)
8. (c)	24. (b)	40. (b)	56. (b)	72. (a)
9. (d)	25. (a)	41. (b)	57. (c)	73. (c)
10. (c)	26. (c)	42. (b)	58. (b)	74. (d)
11. (b)	27. (a)	43. (d)	59. (d)	75. (d)
12. (b)	28. (a)	44. (c)	60. (a)	76. (c)
13. (d)	29. (d)	45. (b)	61. (b)	77. (b)
14. (b)	30. (b)	46. (a)	62. (c)	78. (b)
15. (d)	31. (a)	47. (b)	63. (d)	79. (b)
16. (b)	32. (d)	48. (d)	64. (b)	80. (d)

81. (b)	104. (d)	126. (b)	148. (c)	170. (c)
82. (a)	105. (d)	127. (b)	149. (c)	171. (a)
83. (a)	106. (b)	128. (c)	150. (b)	172. (a)
84. (a)	107. (d)	129. (b)	151. (d)	173. (a)
85. (a)	108. (b)	130. (c)	152. (d)	174. (none)
86. (c)	109. (a)	131. (c)	153. (d)	175. (a)
87. (c)	110. (c)	132. (c)	154. (d)	176. (b)
88. (b)	111. (d)	133. (b)	155. (d)	177. (c)
89. (a)	112. (b)	134. (a)	156. (a)	178. (a)
90. (d)	113. (a)	135. (b)	157. (a)	179. (a)
91. (d)	114. (b)	136. (d)	158. (d)	180. (c)
92. (d)	115. (a)	137. (b)	159. (b)	181. (b)
93. (c)	116. (a)	138. (a)	160. (c)	182. (b)
94. (c)	117. (c)	139. (d)	161. (a)	183. (a)
96. (b)	118. (b)	140. (d)	162. (b)	184. (b)
97. (b)	119. (b)	141. (d)	163. (b)	185. (a)
98. (c)	120. (c)	142. (d)	164. (d)	186. (b)
99. (d)	121. (b)	143. (none)	165. (c)	187. (a)
100. (d)	122. (d)	144. (b)	166. (c)	188. (b)
101. (b)	123. (b)	145. (b)	167. (a)	189. (b)
102. (c)	124. (b)	146. (c)	168. (c)	
103. (a)	125. (none)	147. (a)	169. (d)	



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