

[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
(2064)

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B. Tech 4th Semester Examination

Electrical Machines-I (N.S.)

EE-221

Time : 3 Hours

Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question from each of the Sections A, B, C & D. Section E is compulsory.

SECTION - A

1. (a) What are the properties of an Ideal Transformer? Derive emf equation of single phase transformer. (2+4=6)
- (b) Draw and explain the phasor diagram of a transformer with winding resistance and leakage reactance. Why transformers are rated in KVA? (6+2=8)
- (c) A 30 KVA, 2400/120-V, 50-Hz transformer has a high voltage winding resistance of 0.1Ω and a leakage resistance of 0.22Ω . The low voltage winding resistance is 0.035Ω and the leakage resistance is 0.012Ω . Find the equivalent winding resistance, reactance and impedance referred to the (i) high voltage side (ii) low voltage side. (6)
2. (a) Distinguish power transformer with distribution transformer. Derive the condition for maximum efficiency of transformer. (2+4=6)
- (b) Discuss the importance and procedure for open circuit and short circuit test of transformer. (8)

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- (c) The maximum efficiency of a 500 KVA, 3300/500-V, 50 Hz, single phase transformer is 97% and occurs at $\frac{3}{4}$ th full load unity power factor. If the impedance is 10%, calculate the regulation at full load, 0.8 p.f. lag. (6)

SECTION - B

3. (a) Discuss the parallel operation of single phase transformers. (6)
- (b) Explain working of auto-transformer and prove that when transformation ratio approaches unity, the amount of copper used approaches smaller value. (6)
- (c) What is Scott connection? An 11500/2300 V transformer is rated at 100 kVA as a two winding transformer. If the two windings are connected in series to form an auto-transformer, what will be the possible voltage ratio. (8)
4. (a) Discuss constructional features of 3-phase transformer. (6)
- (b) Explain in detail the effect of (i) current harmonics (ii) voltage harmonics on the performance of 3 phase transformers. How the harmonics can be suppressed using star/delta earthing transformer? (8)
- (c) A 3-phase, delta/star connected 11000/440V, 50Hz transformer takes a line current of 5A, when secondary load of 0.8 lagging p.f. is connected. Determine each coil current and output of transformer. (6)

SECTION - C

5. (a) Describe the construction and working of D.C. generator. (8)
- (b) Derive the emf equation of D.C. generator. (6)

- (c) A long-shunt compound generator delivers a load current of 50A at 500V and has armature, series field and shunt field resistance of 0.05Ω , 0.03Ω and 250Ω respectively. Calculate the generated voltage and armature current. Allow 4V per brush for contact drop. (6)
6. (a) What is Armature reaction? Discuss its effects. (6)
- (b) Discuss the methods to improve commutation in D.C. generator. (6)
- (c) Briefly describe the operating characteristics of D.C. generator. (8)

SECTION - D

7. (a) Derive condition for maximum power in D.C. motor. Why DC series motor is used for traction purpose? (6)
- (b) Discuss the characteristics of DC shunt motor. (6)
- (c) A 20 HP, 230 V, 1150 rpm, 4 pole dc shunt motor has a total of 620 conductors arranged in two parallel paths and yielding an armature circuit resistance of 0.2 ohm. When it delivers rated power at rated speed, it draws a line current of 74.8 A and a field current of 3A. Calculate (i) flux per pole (ii) torque developed (iii) rotational losses (iv) total losses expressed as % of power. (8)
8. (a) Discuss Ward-Leonard system of speed control of DC motor. (6)
- (b) What is the necessity of starter in DC motor? Describe the salient features of three point starter. (8)
- (c) A DC series 200V motor runs at 500 rpm when taking a line current of 25A. The resistance of the armature is 0.2Ω and that of series field 0.6Ω . At what speed will it run, when developing the same torque when armature divertor of 10Ω is used? Assume a straight line magnetisation curve. (6)

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SECTION - E

9. Give brief answer to the following:
- (a) Does transformer draw any current when secondary is open? Why?
 - (b) What kind of material is used for construction of transformer core and why?
 - (c) Full load copper loss in a transformer is 1600W. What will be the loss at half load?
 - (d) Why tertiary winding is used in transformers?
 - (e) How does change in frequency affect the operation of a given transformer?
 - (f) Why armature core in DC machines is constructed with laminated steel sheets instead of solid steel sheets?
 - (g) Define critical field resistance of DC shunt generator.
 - (h) Give importance of back emf in DC motor.
 - (i) What are the applications for DC compound motors?
 - (j) How will you change the direction of rotation of DC motor? (2×10=20)