

Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination:

End Semester Examination for Regular Spring Semester 2022

B. Tech. May 2022 (End Term)

Branch : Electrical & Electronics Engineering

Semester : IV

Title of the Course : Electrical Machines-I

Course Code : EE251

Time: 3 Hours

Maximum Marks: 50

Note-1: Answers should be relevant and to the point and it should be supported by necessary diagram/characteristics plots/phasor diagrams etc. (where ever required). Assume any missing data.

SECTION-A (5 Marks)

Note-2: Attempt all five questions, each question carries 1 mark.

- Q1. i. Explain dynamically and statically induced emf. Which of the two type of emf is induced in transformers and rotating machines and why.
- ii. Explain the phenomenon of torque production in a dc motor through concept of interaction of magnetic fields.
- iii. Why speed control of dc motors is needed? What are the possible methods for the same.
- iv. Explain the various losses taking place in a dc generator and dc motor with the help of relevant power flow diagram.
- v. Explain with proper justification why dc series motor should not be started at no-load.

SECTION-B (25 Marks)

Note-3: Attempt all five questions, each question carries 5 mark.

- Q2. Explain the advantages/limitations of auto-transformers over two winding transformers with proper justification and mathematical formulations.
- Q3. Explain parallel operation of transformer with suitable phasor diagram for the cases when (a) $\frac{X_{ea}}{R_{ea}} = \frac{X_{eb}}{R_{eb}}$ and (b) $\frac{X_{ea}}{R_{ea}} \neq \frac{X_{eb}}{R_{eb}}$
- Q4. Explain, with the help of appropriate characteristics, the possible reasons for the failure of voltage build up in a dc shunt generator. Also suggest the suitable troubleshooting solution for each case.
- Q5. Explain Armature Reaction with suitable phasor diagram elaborating its effect on the performance of dc machine and on the commutation process. Also describe the methods of limiting the effects of armature reaction.
- Q6. Derive the mathematical relationship between (i) Speed-Armature current, (ii) Torque-Armature current, and (iii) Speed-Torque for each of the following motors: (a) DC Shunt Motor (b) DC Series Motor. Also draw the neat characteristics for each case.

SECTION-C (20 Marks)

Note-4: Attempt all four questions, each question carries 5 marks.

- Q7. Two single-phase transformers rated 600 kVA and 500 kVA respectively, are connected in parallel to supply a load of 1000 kVA at 0.8 lagging power factor. The resistance and reactance of the first transformer are 3% and 6.5% respectively, and of the second transformers 1.5% and 8% respectively. Calculate the kVA loading and the power factor at which each transformer operates. (5 marks)
- Q8. A 24 kVA, 2400/240 V, 50 Hz step down transformer has $R_1=25\ \Omega$, $X_1=35\ \Omega$, $R_2=250\ \text{m}\Omega$, $X_2=350\ \text{m}\Omega$, and $X_m=3\ \text{k}\Omega$. The efficiency of the transformer is maximum when it operates at 80% of its rated load and 0.866 pf lagging. Determine (a) its kVA rating at maximum efficiency, (b) maximum efficiency, (c) efficiency at full load and 0.866 p.f. lagging, (d) equivalent core loss resistance. (5 marks)
- Q9. A 230 V dc shunt motor runs at 900 rpm at no load, while taking an armature current of 2 Amps. The armature resistance including brushes is 0.5 ohms. At rated load and rated voltage, the armature current is 20 Amps. Find the speed regulation if: (a) resistance of 2 ohms is placed in series with armature and 3 ohms in parallel with it, (b) only 3 ohms resistance is inserted in series with the armature. Neglect rotational losses and armature reaction. (5 marks)
- Q10. A 60 kW, 250 V shunt motor takes 16 A when running light at 1,440 rpm. The resistance of the armature and field are 0.2 Ω and 125 Ω respectively when hot. (a) Estimate the efficiency of the motor when taking 152 A. (b) Also estimate the efficiency if working as a generator and delivering a load current of 152 A at 250 V.

*****Best of Luck*****