Name:
Roll No. :

End Semester exam
EEL101: Basic Electrical Engineering

Exam duration: 180 mins
Date: 05/05/2025

Instructions:

a. There are total 50 questions and each question carry 1 mark. Questions are of either one word answer type or MCQ.
b. No step marking is there, marks will be awarded only for the complete correct answer.
c. For MCQs, mention the option (a, b, c, or d) of the correct answer. Only one option must be there for each MCQ. In case of multiple options mentioned as answer, zero mark will be awarded even if one of the answers is correct
d. Mention the answer in the units asked in the question. Answer in other units will be regarded incorrect.

A single-phase load is supplied through a 10MVA, 35-kV/3500-V transformer whose series impedances on the HV side is 0.3 + j0.9 Ω and the series impedance on LV side is 0.003 + j0.009 Ω. The LV side contains 528 turns. The shunt branch admittance is (0.00001 – j .0002) referred to HV side. Operating frequency is 50 Hz. (Q1-Q8)

1. The peak flux in the core (in Wb) when operating at rated input voltage is:
2. The number of turns on the HV side is
3. The base impedance of the transformer on HV side and LV sides are (in ohm):
4. The total transformer series impedance in ohm, referred to LV side (R+jX form):
5. The value of core loss resistance and magnetizing reactance in ohms, referred to LV side
6. The value of core loss (in W) under rated voltage is
7. Neglecting the series impedance, the magnitude of no-load current (A) when rated voltage is applied to LV side is
8. The power factor of no load current is: (neglecting the series impedance)

The transformer is required to be operated at 90 Hz keeping the maximum flux density same as the flux density when it was operated with the rated voltage at 50 Hz. (Q9-Q10)

9. The rms value of 90 Hz voltage that is applied on the LV side is (in V):
10. At 90 Hz, the hysteresis loss becomes x times the hysteresis loss at 50 Hz and eddy current loss becomes y times of eddy current loss at 50 Hz. The values of x and y are:
11. The power factor of no load current is: (neglecting the series impedance)

a. Very low and lagging	b. Unity	c. Lagging and close to unity	d. Very low and Leading

12. Flux density of a transformer can be reduced by reducing which quantity:

a. No of turns	b.Supply frequency	c. Time period of supply voltage	d. cross sectional area of core

Figure 1 shows an inductor made up of two C-cores. Each core has area Ac and mean length lc. There are two air gaps, each of length g and effective area Ag. There are two N-turn coils as shown which are electrically connected in series. The relative permeability of core is 2500. Ac = Ag = 38.7 cm², Core-length (including both cores): lc = 95 cm, Gap length: g = 12 mm The resistance of each coil is 100Ω. And the number of turns in each winding is 65 (Q13-Q16)

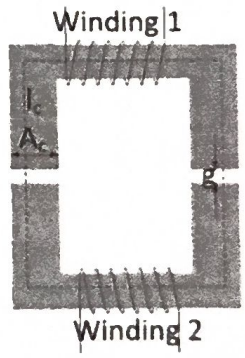

Fig. 1

13. The inductance value of the inductor (in mH) when both windings are connected in series is. (Flux of both coils add).
14. The induced EMF when the are supplied with a 150V DC source is (in V):
15. The flux density in the air gap (in T) when 150V DC voltage is applied is:
16. The core loss and copper loss when supplied with 150V DC voltage is (in W):
17. If the inductor is to be used for high frequency application, the core can be made up of Silicon steel. True/False

A 220 V shunt dc generator supplies 4 kW at a terminal voltage of 220 V when operated at 1450 rpm. The armature resistance being 0.4 Ω and field resistance is 440 Ω (Q16-Q21)
Keeping the flux unchanged (Q18-Q19):

18. If the machine is now operated as a motor at the same terminal voltage with the half the armature current as in generator case, The speed under motoring mode is (rpm).
19. The load torque under this condition is (motoring) (Nm):

It is required to decrease flux/pole by 10% as the operation is changed over from generator to motor. Under this condition (Q20-Q24)

20. The value and connection of resistance to be added with field winding to achieve this change in flux is (in Ohm):
21. The machine is to be operated as a motor at the same terminal voltage with the half the armature current as in original generator case (with higher flux), calculate speed under motoring mode (rpm).

22. The load torque under this condition is (motoring) (Nm):
23. The current drawn by this machine when the rotor stalls is (A):
24. The torque generated by the motor when rotor stalls is (Nm):
25. For a series DC motor, torque is proportional to I_a^x, where I_a is armature current. The value of x under unsaturated flux condition is _____ and under saturated flux condition is _____.

a. 1,2	b. 2,2	c. 1,1	e. 2,1

26. For a DC machine, core losses are _____ than copper losses (Higher/lower)
27. To build up voltage in a self excited DC generator, a _____ needs to be connected initially which can be disconnected once the generator starts supplying voltage.

a. Capacitor	b. Battery	c. Resistor	d. Inductor

28. The windings to compensate for armature reaction are connected in _____ with the armature windings.

a. Series	b. Shunt	c. Isolated	d. None

29. In a _____ excited DC motor, the speed variation with load is minimum

a. Separate	b. Series	c. Permanent Magnet	d. Shunt

30. In a series DC machine, flux can be _____ using a diverter resistance (increased/reduced)

A 10 pole Induction machine operating with a 415V, 3 phase, 50 Hz supply is operating at a slip of 3% and is delivering 12.8 kW to the load. The power lost in friction is given by $0.0038\omega^3$ where ω is rotor speed in rad/sec and stator losses to be 600W (Q31-Q37)

31. Friction torque (in Nm) at the given operating condition is:
32. The torque being delivered to the load (in Nm) is:
33. The frequency of currents induced in rotor is (Hz):
34. Rotor copper loss is equal to (W):
35. Power drawn by the machine from supply mains is (W):
36. Air gap power is equal to (W):
37. Efficiency of the machine is (%):
38. Assuming Rth=Xth=0, for an induction machine to generate maximum torque at the starting:

a. $R_2' > X_2'$	b. $R_2' < X_2'$	c. $R_2' = X_2'$	d. $R_2' = 0$

39. An induction machine with zero resistance in the rotor will

a. Generate no torque	b. Generate very high torque	c. Rotate at very high speed	d. Have 100% efficiency

40. For an induction machine to generate a negative torque (ω_s and ω_r are synchronous speed and rotor speeds resp):

a. $\omega_s > \omega_r$	b. $\omega_s < \omega_r$	c. $\omega_s = \omega_r$	d. $\omega_s = 0$

41. The direction of rotation of an induction machine can be reversed by:

a. Changing phase sequence	b. Applying voltage in reverse polarity	c. Applying very high voltage	d. Increasing rotor resistance

42. The main reason why power factor of an induction machine is poor is:

a. Air gap	b. Rotor inductance	c. Rotor resistance	d. Slip

43. Rotor resistance can be changed in which type of Induction machine (IM):

a. Squirrel cage IM	b. Wound rotor IM	c. No	d. All types of IM

44. In an induction machine, power transfer from stator to rotor takes place by:

a. No power transfer takes place	b. Brushes and commutator	c. Brushes and slip ring	d. Electromagnetic Induction

45. The time taken by a fuse to melt when rated current is flowing is:

a. Zero	b. Very low	c. Infinite	d. Large

46. The delay characteristic of a given MCB can be adjusted while in operation. True/false
47. Which of the following events results in maximum current

a. Overload	b. Short circuit	c. Fault to ground	D. Undervoltage

48. A _____ type fuse can be reset after use:

a. Open	b. Glass/cartridge	c. Explosion	d. High rupturing capacity (HRC)

49. An RCCB to a single-phase supply operates when two lines touch each other. True/false
50. Resistance of a wire does not depends on:

a. Frequency of current	b. Length/area	c. Length*area	d. Temperature