PESIT Bangalore South Campus

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Department of Electronics & Communication Engineering

Question Bank for Basic Electrical Engineering

DC CIRCUITS

1. State and Explain Ohm's Law. Write in brief about the limitations of Ohm's Law.
2. State and explain Kirchhoff's laws.
3. Write in brief about disadvantages of series circuit and advantages of parallel circuits.
4. A length of the wire has resistance 4.5 ohm. Find the resistance of another wire of the same material three times as long and twice the cross sectional area.
5. Four resistors 2 ohm, 3 ohm, 4 ohm & 5 ohm respectively are connected in parallel, what voltage must be applied to the gap in order that total power of 100 watts may be absorbed.
6. A resistance R is connected in series with a parallel circuit comprising two resistors 12 ohm and 8 ohm respectively .The total power dissipated in the circuit is 70 watts when applied voltage is 22 volts .Calculate value of R.

ELECTROMAGNETISM

7. Define/Explain the terms magnetic field, magnetic flux, magnetic flux density, magneto motive force, permeability and reluctance.
8. State and explain Faraday's and Lenz's laws. State and illustrate with sketches Fleming's left and right hand rules.
9. What are leakage flux and leakage coefficient?
10. Explain statically and dynamically induced emf, self- and mutually-induced emf, inductance, and coefficients of self and mutual inductance.
11. Obtain an expression for the energy stored in a magnetic field.
12. An iron ring of mean length 100cm with an air gap of 2mm has a winding of 400 turns carrying 3A. The relative permeability of iron is 600. Find the air gap flux density. Neglect fringing.
13. In problem 12, find the current given that the required air gap flux is 0.5mwb taking leakage factor to be 1.2. Area of cross section is 25cm^2.
14. Two 200 turn air-cored solenoids, 25cm long have a cross-sectional area of 3cm^2 each. The mutual inductance between them is 0.5μH. Find the self-inductance of the coils and the coefficient of coupling.
15. A flux of 0.5Mwb is produces in a coil of 900 turns wound on a wooden ring by a current of 3 A .Calculate
    i) Inductance of coil
    ii) Average emf induced e.m.f. induced in it when acurrent of 5A is switched off assuming current to fall to zero in 1 ms
    iii) The mutual inductance between the coils of a second coil of 600 turns was uniformly wound over the first.

SINGLE PHASE AC CIRCUITS

16. Define/Explain the following terms wrt alternating quantities: a) Phase & phase difference and b) Frequency and period.
17. Define and hence specify/find the instantaneous value, peak value, RMS value, average value, form factor and peak factor of a signal of the form $a(t)=A_m\cos(\omega t+\theta)$.
18. Briefly outline phasor representation of alternating quantities. State all the assumptions and conventions clearly and explicitly.
19. Justify: "*A phasor is not a vector. Phasors and vectors cannot be represented on the same plane.*"
20. Given any number of 15Ω resistors, how can a 9.6Ω resistor be realized? It is not permitted to cut or break the given resistors.
21. Show that the average power consumed in a pure capacitor and in a pure inductor is zero.
22. Define power factor, explain its significance and establish the phase relationship between voltage and current in series and parallel combinations of a) *RL* circuit, b) *RC* circuit and
c) *RLC* circuits (for different cases). Sketch the phasor diagrams and impedance diagrams in all the cases. Also, specify the nature of pf of (i) an electric iron, (ii) a fluorescent lamp, (ii) an incandescent lamp, (iv) a bank of pf improving condensers and (v) an induction motor.
23. Distinguish between series and parallel *RLC* resonance.
24. Show that the average power consumed is $VI\cos\phi$ where V, I, $\cos\phi$ are respectively the supply emf, the supply current and the overall pf.
25. Explain the terms 'reactance' and 'impedance' with suitable examples.
26. Define reactive power and overall power and obtain expressions for them. Bring out their significance. Specify their units.
27. A coil when connected to 200V, 50Hz supply takes a current of 10A and dissipates 1200W. Find the resistance & reactance of the coil. Find also the real power, reactive power and overall power. Sketch the phasor diagram.
28. A coil of 50Ω and 0.5H is connected across 200V, 50Hz supply. Find a) Inductive reactance, b) Circuit impedance, c) Supply current, d) Power factor, e) Phase angle, f) Voltages across *R* & *L* and g) Active, reactive and overall (apparent) power. Obtain expressions for voltage and current. Also sketch the complete phasor and vector diagrams.
29. A capacitor of 15μF is connected in series with a non-inductive resistance of 100Ω across a 100V, 50Hz supply. Find a) Capacitive reactance, b) Impedance, c) Current, d) Power factor, e) Phase angle, f) Voltages across *R* & *C* and g) Power dissipated. Obtain expressions for voltage and current. Also sketch the phasor and vector diagrams.
30. An *RLC* series circuit has the following data. R=25Ω; L=150MH; C=20μF; 250V 50Hz supply. Determine the supply current and the various voltage drops. Represent them in a phasor diagram.
31. A choke is connected in series with a non-inductive resistor across a 250V, 50Hz supply. It draws a current of 5A. The voltage across the coil and the non-inductive resistance are 125V & 200V respectively. Find: a) R, X, Z & Y, b) Power loss in the coil, and c) Total power supplied. Sketch the phasor and impedance diagrams.

32. An emf of 100 sin ($314t$ – 45^0) V is applied to a circuit and the current drawn by the circuit is 20 sin ($314t$–95^0) A. Find the frequency. Give series and parallel realizations for the circuit.
33. Two impedances Z_1 =(150-j157)Ω & Z_2 = (100+j100)Ω are connected in parallel across a 200V, 50Hz supply. Find a) Branch currents, b) Total current and c) Complex power, and d) Total power. Sketch the complete phasor and admittance diagrams.

THREE PHASE AC CIRCUITS

34. With a schematic, explain the principle of generation of 3-phase emf. What are the characteristics of balanced supply? When is a load said to be balanced? Establish the relationship between the phase & line currents and voltages in a 3ϕ delta. In the case of balanced supply and load, (a) are the phase voltages equal? (b) are the line currents equal? Justify your answers. Sketch the complete phasor diagrams in every case.
35. . Explain the concept of 'phase sequence'. Establish the relationship between the phase & line currents and voltages in a 3ϕ star with 3-wire and 4-wire systems. In the case of balanced supply and balanced load, (a) are the line voltages equal? (b) are the phase currents equal? Justify your answers. Sketch the complete phasor diagrams in every case.
36. Show with a relevant phasor diagram how 3-phase power can be measured by two wattmeters. Clearly state the necessary assumptions.
37. Show with a relevant phasor diagram how 3-phase power factor can be measured by two wattmeters. Clearly state the necessary assumptions.
38. Two wattmeters are used to measure the power in a 3ϕ balanced system. What is the power factor when a) both the meters read equal, b) one meter reads twice the other, c) one meter reads zero and d) one meter reads negative?
39. What are the advantages of a 3ϕ system over a single-phase system?
40. Three coils each of impedance $20\angle 60^0\,\Omega$ are connected in star across a 400V, 3ϕ, 50Hz supply. Find the reading on each of the two wattmeters connected to measure the power input. If the same impedances were connected in delta across the same supply, find the corresponding readings of the wattmeters. Find the reactive power and the apparent power.
41. A balanced 3ϕ star connected load of 150kw takes a leading current of 100A with a line voltage of 1100V, 50Hz. Find the circuit constants of the load per phase.
42. A 400V, delta connected 75 HP induction motor operates at 85% efficiency at 0.8pf. Find the readings of the wattmeters connected to measure power by the two-wattmeter method.
43. Prove or disprove: `With a star connected load, the sum of the line currents is zero' implies `supply is balanced'.
44. A balanced star connected load of (8+j6) ohm per phase is connected to 3 phase , 230 V supply .Find the line current ,power factor ,power ,reactive volt-ampere

TRANSFORMERS

45. Explain the construction & principle of operation of 1ϕ transformer. Derive the emf equation of a transformer. Show that emf/turn for primary & secondary are same. Show that the emf ratio is the reciprocal of the current ratio.
46. What are the losses in a transformer? On what factors do they depend? How are losses reduced in a transformer by construction?
47. Explain with neat sketches the core and shell type transformers.
48. Define and explain the terms *efficiency* and *regulation* of a transformer.
49. A 125kVA transformer has a primary voltage of 2000V at 60Hz with 182 & 40 turns on primary and secondary respectively. Neglecting the losses calculate a) no load secondary emf b) full load primary & secondary currents and c) flux in the core.
50. A 25kVA transformer has an efficiency of 97% both at FL and at half load at 0.8pf. Determine a) full load iron & copper loss, b) efficiency at 75% FL and c) max efficiency.
51. A 25kVA, 2200/250V transformer has an iron loss of 600W & full load copper loss of 1000W. Calculate efficiencies at i) full load ii) 75% load iii) 50% load iv) 25% load at upf. & 0.8pf lag, v) losses at max.efficiency, vi) load for max.efficiency and vii) max.efficiency at upf.
52. The iron and full load copper losses in a 40kVA, 1ϕ transformer are 450W & 850W respectively. Find i) efficiency at full load, 0.8pf lag ii) max efficiency and iii) load at which the max. efficiency occurs.
53. A 50kVA transformer has an efficiency of 98% at full load 0.8pf and 97% at half load 0.9pf. Determine the full load iron and copper losses. Find the load at which max. efficiency occurs as also the max. efficiency.
54. Give reasons for the following: a) Core loss in a transformer remains almost constant, b) A regulation close to zero is desirable in a transformer, and c) A laminated steel core is used in a transformer.
55. The regulation of a transformer is negative.' What does this signify? When can such a situation occur?
56. What are the main parts of transformer? What is the function and main material of construction in each case.
57. The maximum efficiency at full load and unit power factor of a single phase , 25kVA 500/1000 V, 50 Hz transformer is 98% Determine efficiency at
    a) 75% load, 0.9 p.f b) 50% load, 0.8 p.f.

SYNCHRONOUS GENERATOR

58. Explain the constructional features and principle of operation of a 3-phase alternator. Justify (i) the deployment of the armature conductors on the stator and the field on the rotor, (ii) the use of short-pitched windings and (iii) the feature of the armature windings being distributed instead of being concentrated, by and large.
59. Starting from basic principles, develop an expression for the emf/phase induced in an alternator.
60. With sketches explain the constructional features of salient pole and non-salient pole alternators. Where are the two types used?

61. Calculate the induced emf/phase in a 4 pole, 3ϕ, 50Hz star connected alternator with 72 slots and 15 conductors per slot. The flux/pole is 0.06Wb. Assume the winding factor to be 0.95, full pitch winding & sinusoidal distribution of flux.
62. Determine the phase & line values of the induced emf in a 4 pole, 3ϕ, 50Hz star connected alternator with 36 slots and 30 conductors per slot. The flux/pole is 50mWb. Assume the winding factor to be 0.95. What is the line emf if connected in delta?
63. A 20 pole, 3ϕ, 50Hz star connected stator winding has 180 slots on the stator. Each slot consists of 8 conductors. The flux/pole is 25mWb and is sinusoidally distributed. The coils are full-pitched. Calculate i) speed, ii) generated emf/phase and iii) line emf.
64. With usual notations, derive the relation $f = PN/120$.
65. What are the salient and nonsalient synchronous machines? Give any two characteristics features of each one of them.
66. Explain the terms pitch factor ,distribution factor and voltage regulation of an alternator
67. A 24 pole turbo alternator has a star connected armature winding with 144 slots and 10 conductors per slot .It is driven by a low speed Kaplan turbine at a speed of 250 revolutions per min. The winding has full pitched coils with a distribution factor of 0.966. The flux per pole is 67.3mWb.Determine a) Frequency and magnitude of line voltage b) The output KVA of the machine if the total current in each phase is 50 A.

DC MACHINES

68. Explain the principle of operation of a dc generator.
69. With a neat sketch explain the construction of a dc generator.
70. Derive the emf equation of a dc generator.
71. Explain the different types of de generators & mention their applications.
72. A 4 pole, wave-wound dc generator has 50 slots and 24 conductors/slot. The flux/pole is 10mWb. Determine the induced emf in the armature if it is rotating at 600 rpm. Solve the same problem if the machine is lap-wound.
73. A 6 pole, wave-wound DC generator has 70 conductors & 12mWb flux/pole. Determine the speed of the armature if the induced emf is 400V. What will be the speed when it is lap wound and generating 400V? Armature reaction weakens the field by 3%.
74. A dc shunt generator supplies a load of 10kW at 250V. Calculate the induced emf if the armature resistance is 0.5Ω and shunt field resistance is 100Ω.
75. A shunt generator has an induced emf of 254V. When the machine is loaded the terminal voltage falls to 240V. Find the load current if the armature resistance and field resistance are 0.04Ω & 24Ω respectively. Brush contact drop is 1.5V/brush.
76. A dc long shunt compound generator delivers a load current of 200A at 500V. The resistance of armature, series field and shunt field are 0.03Ω, 0.015Ω & 15Ω respectively. Calculate the emf induced in the armature. Assume a brush drop of 1V per brush.
77. Solve Problem 85 for a short shunt compound generator.
78. Explain the principle of operation of a dc motor.
79. Explain the significance of back emf of a dc motor. Derive an expression for the back emf.
80. Derive the torque equation of a dc motor.
81. Explain the different types of dc motors. Mention their applications.

82. Sketch and explain the following characteristics for series, shunt, compound motors. a) Torque v/s armature current; b)Torque v/s speed; and c) Armature current v/s speed.
83. What are the purposes to be served by a dc motor starter? With a neat sketch explain the working of a 3-point starter.
84. A 20kW, 200V dc shunt generator has a armature and field resistances of 0.05Ω and 150Ω respectively. Determine the total current and power developed when working as a motor taking 20kW power.
85. A 250V dc series motor has an armature resistance of 0.05Ω and field resistance of 0.02Ω. It runs at 900rpm taking 30A. Determine its speed when it takes a current of 25A.
86. A dc shunt motor runs at 950 rpm on 200V with 40A armature current. Its armature resistance is 0.8Ω. What resistance is required to be connected in the armature circuit to reduce the speed to 725 rpm without changing the armature current?
87. Give reasons
    a) Armature winding placed on the rotor in a DC machine
    b) Shunt motors are use for constant speed application
    c) Series motor should not be started without proper load
88. A 6 pole DC shunt motor has a lap connected armature with 492 conductors. The resistance of armature is 0.2 ohm and the flux per pole is 50 mWb. The motor runs at 20 revolutions per second when it is connected to a 500 V supply for a particular load .What will be the speed of the motor when the load is reduced by 50%. Neglect contact drop and magnetic saturation.

THREE PHASE INDUCTION MOTOR

89. How is a rotating magnetic field produced in the air gap of a 3ϕ induction motor?
90. Explain the principle of operation and constructional features of a 3ϕ induction motor.
91. Define and explain slip in an induction motor.
92. What are squirrel cage and wound-rotor induction motors? What are their relative advantages and disadvantages? Mention their applications.
93. Why does an induction motor require a starter? With a neat diagram explain the principle of operation of a star-delta starter.
94. A 3ϕ, 9 pole, 60Hz induction motor has a slip of 3% at full load. Find the synchronous speed and the frequency of rotor current at full load.
95. What is the maximum possible rpm of a 50Hz induction motor? Why?
96. Define synchronous speed, slip speed and motor speed of a 3 phase induction motor Explain why induction motor cannot run at synchronous speed.
97. The rotor induced voltage of 3 phase ,4 pole squirrel cage induction motor fed by a salient pole alternator is observed to make 1.5 alterations per second .The star connected alternator with 592 full pitched armature conductors in series per phase with a distribution factor of 0.966 develops a line voltage of 6600 volts when the flux per pole is 60mWb Determine the speed of the Induction motor.

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DOMESTIC WIRING & MEASURING INSTRUMENTS

98. What are the different types of wiring? Mention their features and applications.
99. Explain with wiring diagrams the working of 2-way and 3-way control of a lamp.
100. Explain why appliances are earthed. With neat sketches, explain plate, pipe and rod earthing.
101. Why are fuses used in electrical appliances?
102. What are the different types of torques encountered in measuring instruments?
103. With neat sketches, explain the construction and operation of a dynamometer type wattmeter and an induction type energy meter.
104. As applied to an energy meter, give reasons for the following:
    - (i) There is a permanent magnet surrounding a portion of the rotating disc;
    - (ii) Holes of the same size are cut on diametrically opposite locations on the disc; and
    - (iii) A copper shading ring is provided on the central limb of the shunt magnet.