KKR & KSR INSTITUTE OF TECHNOLOGY & SCIENCES
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Unit 1,2 &3 DC Machines question bank

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1) Discuss principle of electromechanical energy conversion with block diagram representation. **(CO212.1 Knowledge)**

2) Define field energy and co-energy and explain their significances. **(CO212.1 Knowledge)**

3) For a single excited magnetic system, derive the relation for the magnetic stored energy in terms of reluctance. **(CO212.1 Application)**

4) Derive an expression for the torque in a doubly exited system having salient pole type of stator as well as rotor. State assumptions made. **(CO212.1 Application)**

5) A) Explain the constructional details of DC machines. **(CO212.1 Comprehension)**

B) Derive the expression for the emf generated in DC machine. **(CO212.1 Application)**

6) Explain the voltage build up process in DC shunt generator. (**CO212.1 Comprehension)**

7) Sketch and explain the characteristics of shunt, series and separately exited generator. **(CO212.1 Comprehension)**

8) What do you mean by armature reaction in D.C. machines? Show on a diagram its effect on the flux distribution. **(CO212.2 Comprehension)**

9) a) Discuss the methods adopted for minimising the sparking at the brushes. **(CO212.2 Comprehension)**

b) A. 4-pole, 50 kW,250 V wave wound, shunt generator has 400 armature conductors. Brushes are given a lead of 4 commutator segments. Calculate the demagnetising ampere –turns / pole if shunt field resistance is 50Ω. Also calculate extra field turns/pole to neutralise the demagnetisation. **(CO212.2 Application)**

10 a) What are the various losses occurring in rotating machines. Mention the methods to reduce them. **(CO212.3 Comprehension)**

b) A 120V DC shunt motor has an armature resistance of 0.2_ and a field resistance of 60. The full load line current and full load speed are 60A and 1800 rpm. If the brush contact drop is 3V. Find the speed of the motor at half load. **(CO212.3 Application)**

11 a) Write short notes on ward-Leonard method of speed control. **(CO212.3 Comprehension)**

b) A 250V DC shunt motor with an armature resistance of 0.5_ runs at 600 rpm on full load and takes an armature current of 20A. If resistance of 1_ is placed in the armature circuit, find the speed at i) Full load torque ii) half-full load torque. **(CO212.3 Application)**

12 a) Explain the Swinburne's test to determine no-load losses of DC machine. What is the limitation of this test? **(CO212.3 Comprehension)**

b) A 220V Dc shunt motor at no load takes a current of 2.5 A. The resistances of the armature and shunt field are 0.8_ and 200_ respectively. Estimate the efficiency of motor when the input current is 20A. State precisely the assumptions made. **(CO212.3 Application)**

13. a) Explain the process of commutation in Dc machines through the reversal of current in a coil **(CO212.2 Comprehension)**

b) Determine the AT/pole for each inter pole of a 4 pole generator with 88 slots each containing 900 ampere - conductors. The inter pole air gap is 0.01m and the flux density in the inter pole air gap is 0.3 T. The effects of iron parts of the circuits and leakage may be neglected. **(CO212.3 Application)**

14. a) Sketch and explain the speed torque characteristics of DC Shunt, series and cumulative Compound motors. **(CO212.3 Comprehension)**

b) A DC Series motor, with unsaturated magnetic circuit and negligible resistance, when running at a certain speed on a given load, takes 50 A at 500 V. If the load torque varies as the cube of the speed, find the resistance to be inserted to reduce the speed by 50 %.**(CO212.3 Application)**

15.Write short notes on the following:

a) Specific Electric and Magnetic Loadings

b) Swinburne's test **(CO212.3 Comprehension)**

16. a) What are the drawbacks of three point starters? Describe a four-point starter with a neat sketch. **(CO212.3 Comprehension)**

b) A 250V, 4-pole, shunt motor has two-circuit armature winding with 500 conductors. The

armature circuit resistance is 0.25 ohms, field resistance is 100 ohms and the flux per pole is 0.03Wb. If the motor draws 14.5A from the mains, compute the speed and the internal (gross) torque developed. Neglect armature reaction. **(CO212.2 Application)**

17. a) What is meant by braking of dc motors? Briefly describe various methods of braking of dc shunt motors. **(CO212.3 Comprehension)**

b) A 500V shunt motor runs at its normal speed of 250 rpm when the armature current is 200A and resistance of armature is 0.12 ohms. Calculate the speed when a resistance is inserted in the field, reducing the shunt field to 80% of normal value, and the armature current is 100A. **(CO212.3 Application)**

7. a) What factors need to be considered for choice of ampere conductors in dc machines? **(CO212.2 Analysis)**

b) List advantages and disadvantages of higher number of poles in dc machine. **(CO212.2 Analysis)**

18. a) Define torque. Derive the expression for torque developed by a DC motor from fundamentals. **(CO212.3 Application)**

b) A 4 – pole, 250 V wave connected shunt motor gives 10 kW when running at 1000 rpm and drawing armature and field currents of 60 A and 1 A respectively. It has 560 conductors. Its armature resistance is 0.2 ohm. Assuming a drop of 1 V per brush, Determine: i) total torque ii) useful torque iii) useful flux per pole iv) rotational losses v) efficiency. **(CO212.3 Application)**

19. a) With a neat diagram explain the construction and working of 3-point starter. **(CO212.3 Knowledge)**

b) A 220 V shunt motor has an armature resistance of 0.5 ohm and takes an armature current of 40 A on a certain load. By how much must the main flux be reduced to raise the speed by 50% if the developed torque is constant? Neglect saturation and armature reaction. **(CO212.3 Application)**

20. What is Hopkinson's test? And why it is called regenerative test? Draw connection and procedure to conduct this test. What are the advantages and disadvantages of this method? **(CO212.3 Application)**

21. a) Discuss armature reaction and commutation in DC motors. Explain their effects on the performance of the motor and give remedies to their effects. **(CO212.2 Analysis)**

b) A 6 – pole, lap wound 400 V series motor has the following data: No. of armature conductors is 920, flux per pole is 0.045 Wb, total motor resistance is 0.6 ohm, iron and frictional losses is 2 kW. If the current taken by the motor is 90 A, find: i) total torque ii) useful torque at the shaft iii) power output iv) pull at the rim of the pulley of 40 cm diameter connected to the shaft. **(CO212.3 Application)**

22. a) What are the different speed control methods of DC shunt motor? Explain each method and enumerate advantages and disadvantages. **(CO212.3 Comprehension)**
b) A 500 V DC shunt motor running at 700 rpm takes an armature current of 50 A. effective armature resistance is 0.4 ohms. What resistance must be placed in series with the armature to reduce the speed to 600 rpm, the torque remaining constant? **(CO212.3 Application)**

23. Describe how a Swinburne's test is conducted on DC machines with neat diagram. State its advantages and disadvantages. **(CO212.3 Comprehension)**

24. a) Explain the significance of back e.m.f in a DC motor. **(CO212.3 Comprehension)**
b) A 200 V DC series motor runs at 700 rpm, when operating at its full load current of 20 A. The motor resistance is 0.5 ohms and the magnetic circuit can be assumed unsaturated. What will be the speed if i) the load torque is increased by 44% ii) the motor current is 10 A. ? **(CO212.3 Application)**

25. a) Explain the method of controlling the speed by Ward-Leonard system. **(CO212.3 Comprehension)**
b) In a 230 V, 10 kW DC shunt motor, it is required that the starting armature current should not exceed twice its rated armature current. During the starting of the motor, the starting resistance is cut out in steps, as soon as the armature current drops to its rated value. The field resistance is 115 ohms and the total armature circuit resistance is 0.348 ohms. Neglect armature inductance. i) Find the external resistance required at the time of starting the motor. ii) Determine the value of the first resistance element that must be cut out, when the armature current drops to rated value. iii) Find the external resistance to be cut out in the second step. ? **(CO212.3 Application)**

26. Explain the retardation test with the help of neat circuit diagram. How the rotational losses are estimated by retardation test. ? **(CO212.3 Comprehension)**

27. a) Explain the characteristics of DC shunt, series and compound motors. ? **(CO212.3 Comprehension)**
b) A 250 V shunt motor takes a current of 41 A and runs at 800 rpm on full load. Armature and field resistances are 0.2 ohm and 250 ohms respectively. If resistance of 2 ohms is placed in the armature circuit, determine i) speed at full load torque ii) speed at double full load torque iii) stalling torque in terms of full load torque. Assume that the fluxes remain constant throughout. **(CO212.3 Application)**

28. a) What is the significance of starter used in the DC motors? Explain the operation of 4-point starter with neat diagram. **(CO212.3 Comprehension)**
b) A series motor takes 20 A at 400 V and runs at 250 rpm. The armature resistance is 0.6 ohms

and field resistance is 0.4 ohms. The torque required by the device varies as the square of the speed. Find the applied voltage and the current to run the device at 350 rpm. **(CO212.3 Application)**

29. Explain the Field's test with neat circuit diagram. What is the aim of this test? **(CO212.3 Comprehension)**

30. a) What is the need of the starter? With a neat diagram explain the construction and working of 3-point stator. **(CO212.3 Comprehension)**

b) A 400 V DC shunt motor taking an armature current of 66.67 A on full load. Calculate number of resistance sections, and resistance of each section, when Ra =0.5 ohms and I should not exceed more than 100 A. **(CO212.3 Application)**

Unit 4,5 &6 Transformers question bank

1. a) Explain the working principle of transformer and derive the emf equation. (CO212.4 Comprehension)

b) A single phase 50 Hz transformer has 100 turns on the primary and 400 turns on the secondary winding. The net cross-sectional area of core is 250 cm^2. If the primary winding is connected to a 230 V 50 Hz supply, determine

i. The EMF induced in the secondary winding

ii. The maximum value of flux density in the core. (CO212.4 Application)

2. a) Prove that the EMF induced in the windings of the transformer will lag behind the flux by 90^0. (CO212.4 Application)

b) Explain how equivalent circuit of transformer can be obtained? (CO212.4 Comprehension)

3. Explain the principle of operation of transformer. Deduce its equivalent circuit. (CO212.4 Comprehension)

4. a) Give the constructional differences between a core type and shell type transformers. How the iron losses are minimized. (CO212.4 Knowledge)

b) A single phase transformer has turns ratio of 144/432 and operates at maximum flux of 7.5 x 10−3 wb at 50 Hz. When on no load the transformer takes 0.24 KVA at a power factor of 0.26 lagging from the supply. If the transformer supplies a load of 1.2 KVA at a power factor of 0.8 lagging, determine

i. Magnetizing current. ii. Primary current iii. Primary power factor (CO212.4 Application)

5. Construct the phasor diagram of the single phase transformer and analyze the primary power factor under RL load condition. (CO212.4 Analyze)

6. a) Explain why hysterisis and eddy current losses occur in a transformer. (CO212.4 Comprehension)

b) A transformer on load takes 1.5 amps at a power factor of 0.2 lagging when connected across 50 Hz 230 V supply. The ratio between primary and secondary number of turns is 3. Calculate the value of primary current when secondary is supplying a current of 40A at a power factor of 0.8 lagging. Neglect the voltage drop in the windings. Draw the relevant phasor diagram. (CO212.4 Application)

7. a) Draw the phasor diagram of a transformer on no load and explain the function of active and reactive components of no load current of transformer. (CO212.4 Application)

b) Explain why transformer rating will be given in KVA but not in KW. (CO212.4 Comprehension)

8. a) Explain the functions of the following in a transformer i. Breather ii. Conservator iii. Oil (CO212.4 Knowledge)

b) Draw and explain phasor diagram of transformer on lagging load. (CO212.4 Application)

9 a) Explain how equivalent circuit of transformer can be obtained (CO212.4 Comprehension)

b) The constants of a single phase 50HZ 2200/220V transformer are as follows

H.V side:r1=0.21 ,x1=3.84 Rc1 =4800 .xm1=3500
L.V side:r2=0.006 ,x2=0.002

Find the equivalent circuit parameters referred to

(i) H.V side and

(ii) L.V side (CO212.4 Application)

10 a) Discuss how will you perform O.C and S.C test on a single phase transformer in the laboratory (CO212.5 Knowledge)

(b) the maximum efficiency of a 500Kva ,3300/500V 50Hz,single phase transformer is 97% and 3/4th full load and unity power factor. if the impedance drop is 10% calculate the regulation at full load and 0.8pf lagging (CO212.5 Application)

11 a) Explain the function of centre tapped reactor in on-load tap changer (CO212.4 Comprehension)

b) Describe one type of on-load tape changer with proper sequence of operation for changing the voltage (CO212.4 Comprehension)

12 a) explain the following with respect to single phase transformer

i) Core

ii) Winding

iii) Methods of cooling

iv) Conservator and bushing (CO212.4 Knowledge)

b) a single phase transformer is connected to a 230V ,50Hz supply the net cross –sectional area of the core is 50cm2 the number of turns of the primary is 460 and the secondary is 80.detrmine i)transformation ratio ii)peak value of the flux density in the core iii)e.m.f in the secondary winding (CO212.4 Application)

13) a)derive EMF equation of a 1-phase transformer (CO212.4 Comprehension)

b) a transformer has a primary windings of800 turns and a secondary of 200turns .when load current on the secondary is 80A at 0.8 p.f lagging .determine the no-load current of the transformer and the phase angle with respect to the voltage (CO212.4 Application)

14 a) explain how do you minimize the hystresis and eddy current losses in a sigle phase transformer (CO212.4 Comprehension)

b) when asingle phase transformer is supplied at 400v ,50Hz ,the hysteresis losses found to be 320watts and eddy current losses is found to be 250watts .determine the hysteresis loss and eddy current losses when the transformer is supplied at 800v, (CO212.4 Application)

15. a) Explain various losses and derive the condition for maximum efficiency of a transformer (CO212.5 Comprehension)

b) The efficiency at unity power factor of 6600/384 volts 100 KVA 50 Hz single phase transformer is 98% both at full load and at half full load. The power factor on no load is 0.2 and the full load regulation at a lagging power factor of 0.8 is 4 %. Draw the equivalent circuit referred to L.V. side and insert all the values. (CO212.5 Application)

16. a) Define efficiency and regulation of a transformer. Show how the power factor affects both of them. (CO212.5 Comprehension)

b) The maximum efficiency of 50 KVA transformer is 97.4 % and occurs at 90 % of the full load. Calculate the efficiency of transformer at

i.) Full load 0.8 power factor lagging

ii.) Half full load 0.9 power factor (CO212.5 Application)

17. A 40 KVA single phase transformer has got maximum efficiency of 97 % at 80 % of full load at UPF. During the day, the load on the transformer is as follows.

No. of hours	Load	Power factor
9	6 KW	0.6 lag

8 25 KW 0.8 lag

7 30 KW 0.9 lag

Determine the All-day efficiency of the transformer. (CO212.5 Application)

18. a) Derive the expression for voltage regulation of a transformer from the simplified approximate equivalent circuit and obtain condition for zero regulation. (CO212.5 Application)

b) The primary and secondary windings of 30 KVA,6000/230V transformer have resistances of 10 Ω and 0.016 Ω respectively. The total reactance of transformer referred to primary is 23 Ω. Calculate the percentage regulation of transformer when supplying full load current at a power factor of 0.8 lagging.

(CO212.5 Application)

19. a) What are the conditions required for the parallel operation of two transformers. (CO212.6 Knowledge)

b) Derive the equations for the currents supplied by each transformer when two transformers are operating in parallel with equal voltage ratios. (CO212.4 Application)

20. a) Explain the procedure to predetermine the efficiency and regulation of a transformer with all necessary equations. (CO212.5 Comprehension)

b) The iron losses in a transformer core at normal flux density were measured at frequencies of 30 and 50Hz and the results being 34W and 55W respectively. Calculate the hysteresis and eddy current losses at 50Hz. (CO212.5 Application)

21. a) Two similar 250KVA similar transformers gave the following results when tested by back-to-back method: Mains wattmeter, W_1 = 5.0 KW, Primary series circuit wattmeter, W_2 = 7.5KW (at full load current). Find out the individual transformer efficiencies at 75% full load and 0.8 power factor lead. (CO212.5 Application)

b) A 10KVA, 440/3300V, 1-phase transformer, when tested on open circuit, gave the following figures on the primary side : 440V, 1.3A, 115W. When tested on short circuit with full load current flowing, the power input was 140W.Calculate the efficiency of the transformer at (i.) full load unity power factor (ii.) one quarter full load 0.8p.f. (CO212.5 Application)

22. a) Explain the procedure for conducting OC and SC tests with neat diagrams. (CO212.5 Comprehension)

b) The following readings were obtained from O.C and S.C test on 8 kVA 400/120 V, 50 Hz transformer, O.C Test (L V Side) : 120V; 4 A; 75 W. S. C Test (H V Side) : 9.5 V; 20 A; 110 W
Obtain i) the equivalent circuit (approximate constants) ii) Voltage regulation and efficiency for 0.8 lagging power factor load, and iii) The efficiency at half – load and 0.8 power factor load
(CO212.5 Application)

23. a) Describe the principle of regulating the voltage with the help of tap-changers. (CO212.6 Comprehension)

b) Discuss whether the winding should be tapped on HV side or LV side. . (CO212.6 Comprehension)

24) A) Draw the equivalent basic circuit of a tertiary winding of a single- phase 3-winding transformer. Also explain the procedure for obtaining its impedances. (CO212.6 Application)

B) Two T- connected single phase transformers are supplying 3-phase balanced load of 33 kVA at 440 V with the primary voltage of 3300V, Calculate i) voltage and current rating of each coil ii) KVA rating of teaser and main transformer. (CO212.6 Application)

25 a) List out the advantages and disadvantages of a bank of 3, 1-phase transformers to single 3-phase transformers. (CO212.6 Knowledge)

b) A ▲/Y connected 3-phase transformer has a voltage ratio of 22Kv (▲)/345Kv (Y) (line-to-line). The transformer is feeding 500 MWAR to the grid (345Kv). Determine the VA and voltage rating of each unit (I-Phase).Compute all currents and voltages to both magnitude and phase angle in all the windings. (CO212.6 Application)

26 a) What precautions should be observed during the operation of on-load tap changer. *(CO212.6 Knowledge)*

b) Explain the function of center-tapped reactor in on load tap changer. (CO212.6 Knowledge)

27. a) Discuss in detail the effect of i.) current harmonics, (CO212.6 Comprehension)
ii.) voltage harmonics on the performance of three phase transformers.

b) Explain how the harmonics can be suppressed using Star/Delta earthing transformer. Draw the relevant connection diagram. (CO212.6 Comprehension)

28. a) Why is it preferable to operate a bank of transformers rather than 3 independent 1phase transformers.

b) A 3 phase transformer bank consisting of three 1-phase transformers is used to step down the voltage of a 3-phase, 6600v transmission line. If primary line-current is 10A, Calculate the secondary line voltage, line current and output KVA for the following connections.

i. Y/▲ and

ii. ▲/Y. The turn's ratio is 12 neglect losses (CO212.6 Application)

29. A ▲/Y connected bank of 3 identical 60 KVA, 2000/100V, 50Hz transformers is fed with power through a feeder whose impedance is 0.75 + j0.25 per phase. The voltage at the sending end of the feeder is held fixed at 2 KV line-to-line. The short circuit test when conducted on one of the transformers with its L.V. terminals short circuited gave the following results:

V_{hv} = 40 V, f = 50Hz , I_{hv} = 35 A, P = 800 W

a) Find the secondary line-to-line voltage when the bank delivers rated current 2A balanced 3-phase u.p.f. load.

b) Calculate the currents in the transformer in the primary and secondary windings and in the feeder wires on the occurrence of a solid 3-phase short circuit at the secondary line terminals. (CO212.6 Application)

30. Two transformers each rated 250 KVA, 11/2 KV and 50 Hz are connected in open delta on both primary and secondary.

a) Find the load KV A that can be supplied from this transformer connection.

b) A delta connected 3-phase load of 250 KVA, 0.8 p.f., 2 KV is connected to the low voltage terminal of this open voltage transformers. Determine the transformer currents on the 11 Kv side of this connection. (CO212.6 Application)