UNIVERSITY OF PETROLEUMAND ENERGY STUDIES

End Semester Examination,December 2017

Program: B Tech Electrical Engineering | **Semester – VII**
Subject (Course): Electrical Machine Design | **Max. Marks : 100**
Course Code : ELEG 472 | **Duration : 3Hrs**
No. of page/s: 02

SECTION-A

20 Marks

1	Describe why plain walled tanks are not used for large output transformers?	**CO2**	**[4]**
2	Explain why real flux density in the teeth is less than the apparent flux density	**CO1**	**[4]**
3	Explain the advantages and disadvantages of Synthesis method?	**CO1**	**[4]**
4	Define (a) Slot space factor (b) Pitch factor	**CO1**	**[4]**
5	A 3phase, 4 pole induction motor has 36 slots. Calculate the order of slot harmonics produced. It is desired to completely eliminate the higher order slot harmonic, find the angle through which the bars must be skewed. Find the effect of skewing on the lower order harmonic.	**CO3**	**[4]**

SECTION-B

40 Marks

6	Find the main dimensions of a 25 kW, 3 Phase, 400V, 50 Hz, 2810 r.p.m., squirrel cage induction motor having an efficiency of 0.82 and a full load power factor of 0.9. Assume: Specific magnetic loading = 0.45 Wb/m^2; Specific electric loading = 23000 A/m; Take the rotor peripheral speed as approximately 30m/s at synchronous speed.	**CO3**	**[10]**
7	Explain the factors which influence the performance of machine and choice of specific magnetic loading	**CO2**	**[10]**
8	Explain the design considerations of squirrel cage and slip ring induction motor (both stator and rotor)	**CO3**	**[10]**
9	Find the main dimensions of a 1250 kVA. 187.5 r.p.m., 50 Hz, 3phase, 3 kV., salient pole synchronous generator. The generator is to be a vertical, water wheel type. The specific magnetic loading is 0.45Wb/m^2 and the specific electric loading is 28000 A/m. use circular poles with ratio of core length to pole pitch=0.65. specify the type of pole construction used if the run away speed is about 2 times the normal speed.	**CO3**	**[10]**

SECTION-C

40 Marks

10 The magnetic circuit of a 440 V, 6 pole, 3 phase, star connected, 50 Hz, induction motor has the following parameters. **CO4** **[20]**

Core length = 0.12m
Stator teeth length = 30 mm
Tooth width at 1/3 height from narrow end = 7 mm
Rotor teeth length = 12mm
Rotor tooth width at 1/3 height from narrow end = 9.5 mm
Stator bore diameter = 0.4 m
Effective air gap length = 0.9 mm
Stator and rotor core depth = 5.5 mm
Mean 60^0 lengths of magnetic circuit per pole pair, in core
Stator 0.25m, rotor 0.15 m.
The stator has 72 slots with 8 conductors per slot
The rotor has 49 slots.
Stacking factor = 0.955
Estimate the magnetizing current using the following magnetization curve.

B (Wb/m^2)	0.5	0.7	1.0	1.2	1.4	1.6
at (A/m)	95	110	200	300	600	2500

11 A 1000 k VA 3300 V, 50 Hz, 400 r.p.m., 3 phase alternator has 180 slots with 5 conductors per slot. Single layer winding with full pitch coils is used. The winding is star connected with one circuit per phase. Determine the specific electric and specific magnetic loadings of the stator bore is 1.8 m and the core length is 0.4 m. using the same loadings, determine the corresponding data for a 2500 kVA. 3300 V, 50 Hz, 750 rpm, 3 phase star connected alternator having 2 circuits per phase. The machines have 60^0 phase spread. **CO4** **[20]**

(OR)

11 Determine the main dimensions of a 50000 kVA 13.8 kV 50 Hz, 300 r.pm., 3 phase star connected alternator. Also find the number of stator slots, conductors per slot, conductor area and work out the winding details. The peripheral speed should be about 20 m/s. **CO4** **[20]**

Assume: Average gap density = 0.45 Wb/m^2,
Ampere conductors per metre= 30000 and
Current density = $4A/n.m^2$.

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SECTION-A

20 Marks

1	Describe the reason behind the transformer oil used as cooling medium? And mention the important characteristics desirable in transformer oil?	**CO1**	**[4]**
2	Explain apparent flux density and real flux density	**CO1**	**[4]**
3	Explain the purpose of providing damper windings in synchronous machines?	**CO2**	**[4]**
4	Define (a) Distribution Factor (b)Short circuit ratio (SCR) and write the expression for it.	**CO1**	**[4]**
5	A 3 phase induction motor has 54 stator slots with 8 conductors per slot and 72 rotor slots with 4 conductors per slot. Find the number of stator and rotor turns. Find the voltage across the rotor slip rings when the rotor is open circuited and at rest. Both stator and rotor are star connected and a voltage of 400 V is applied across the stator terminals.	**CO3**	**[4]**

SECTION-B

40 Marks

6	A 3 phase 2 pole, 50 Hz squirrel cage induction motor has a rotor diameter 0.22 m and core length 0.10 m. the peak density in the air gap is 0.45 Wb/m^2. The rotor has 33 bars, each of resistance 145 μΩ and a leakage inductance 3μH. the slip is 6%. Calculate (i) the peak value of current in each bar(ii) rotor I^2R loss (iii) rotor output and(iv) torque exerted. Neglect the resistance of end rings.	**CO3**	**[10]**
7	Describe the effect of higher values of specific electric loading and specific magnetic loading in design of Electrical Machines?	**CO2**	**[10]**
8	Calculate the ampere turns for the air gap of a machine using the following data. Core length = 32cm, number of ventilating ducts = 4, width of duct = 1.0cm, pole arc of ventilating ducts = 4, width of duct = 1.0cm, pole arc = 19cm. Slot pitch = 5.64 cm, semi-closed slots with slot opening = 0.5cm, air gap length = 0.5cm, flux/pole =	**CO3**	**[10]**

0.05Wb.

9	Explain the design of transformer tank with suitable dimensions and describe the methods of cooling of transformers.	**CO3**	**[10]**

SECTION-C

40 Marks

10	Determine the main dimensions of the core and window for a 500 kVA, 6600/400 V, 50 HZ single phase core type oil immersed self-cooled transformer Assume: flux density= 1.2 T; Current density= 2.75 A/mm^2; Window space factor= 0.32; Volt/turn= 16.8; Type of core= cruciform core; Height of window= 3 times window width Calculate the number of turns and cross sectional area of the conductors used for the primary and secondary windings	**CO4**	**[20]**
11	The following is the design data available for a 100 kVA 3 phase, 50 Hz, 440 V, star connected 300 r.p.m alternator of salient pole type: Stator bore D=2.0 m Stator core length L= 0.15 mm Pole arc/pole pitch = 0.66 Turns per phase= 150 Single layer concentric winding with 5 conductors per slot Short circuit ratio = 1.2 Assume that the distribution of gap flux is rectangular under the pole arc with zero values in the inter polar region. Calculate: (i) Specific magnetic loading (ii) Armature mmf per pole (iii) Gap density over pole arc (iv) Air gap length MMF required for air gap is 0.88 of no load field mmf and the gap contraction factor is 115.	**CO4**	**[20]**

(OR)

11	A 1250 kVA, 3 phase 50 Hz, 3300 V, 300 rpm synchronous generator with a concentric winding has the following design data: Specific magnetic loading = 0.45 Wb/m^2 Specific electric loading =28000 A/m Gap length = 5.5. mm Field turns per pole = 60 Short circuit ratio = 1.2 The effective gap area is 0.6 times the actual area Peripheral speed is 20 m/s. Find the stator core length, stator bore, turns per phase, mmf for air gap, armature mmf per pole, and the field current for no load and rated voltage.	**CO4**	**[20]**