Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online End Sem Examination, Dec 2020

Open Book Examination

Course: Electrical Machine Design — **Semester: VII**
Programme: B.Tech Electrical Engg & B.Tech PSE — **Max Marks:100**
Subject Code: EPEG4001 — **Duration: 3 Hrs**

S. No.		CO
	Section A	
Q.1	Two transformers each have rating of 11 kV/440V, 630 kVA, 50Hz. Both transformers have identical design parameters except number of steps. Transformer 'A' has Three-step core and transformer 'B' has four step core. The tested full load efficiency for one of transformer is 99.5% and for other transformer it is 99%. From above information, which transformer (Transformer 'A' or Transformer 'B') will have efficiency of 99%? (If required take flux density of 1.7 wb/m^2)	**CO2**
Q.2	A 350 kW (Pa), 500 V (Ea), 400 RPM DC motor was designed with Bav = 0.35 wb/m^2 and ac = 28,000 AC. After designing and fabricating machine, flux density was measured in the various parts of machine like Air Gap, Armature core, Tooth Bottom, Pole Shank & Yoke. The experimental results shows flux densities of 1.75 wb/m^2, 0.63 wb/m^2, 1.3 wb/m^2, 1.4 wb/m^2 & 2.05 wb/m^2 (not in same sequence as above). Which one of these values must belongs to Flux density at tooth bottom?	**CO1**
Q.3	A 3-Phase, 800 kVA (Sa), 3.3 kV, 50 Hz, 1390 rpm Induction motor is designed with squirrel cage rotor. The permitted temperature rise for machine is 110^{o}C. If Bav = 0.31 wb/m^2, ac = 32,000 AC. Write value of Poles, D & L for best overall design.	**CO3**
Q.4	With respective Synchronous generator write (Match the Pair) A) Distributed Winding — P) Saving of copper — A= (?) B) Short Pitch winding — Q) Small Alternators — B= (?) C) Rotating Armature — R) Very Large alternators — C = (?) D) High Speed Alternator — S) Small Diameter — D = (?) E) Hydrogen Cooling — T) Sinusoidal Voltage — E = (?)	**CO4**
Q.5	The estimated values of a 3-Phase IM are, D = 0.7 m, L = 0.4 m, Poles = 4, Slops/pole/pitch = 4, depth of slot = 50 mm. (parallel sided slot). What is area of slot?	**CO3**
Q.6	In an induction motor stator copper losses are 4 kW. If all other design parameters remain same, what will be the value of new stator copper losses, if current density is increased by 10%.	**CO5**
	Section 'B'	
Q.1	While designing a DC motor for a specific rating, 4 poles or 6 poles can be chosen. The designer has chosen 4 poles. With 4 poles design, the pole shank height was 15 cm. Without changing any other parameter, if designer had chosen 6 poles, what would have been height of poles?	**CO1**
Q.2	In Design engineer's prospective explain (for Induction motor)	**CO5**

	a) Selection of current density and its effect on performance of motor b) Air gap length and its effect on performance of IM.	
Q.3	Two Synchronous generators have identical rating, but having different synchronous speeds, explain effect on: a) Main Dimensions of machine. b) Cooling of machines.	**CO4**
Q.4	A 400 kW (Pa), 400 V (Ea), 4 pole DC motor is designed with Lap winding. Estimate the minimum number of brushes per brush arm and loading per brush?	**CO1**
Q.5	Estimate the volume of armature bore for a Synchronous generator with following specifications: 200 MVA (Sa), 4 Pole, 11 kV, 1500 RPM, Hydrogen Cooled. (Select suitable value of Bav & ac with justification)	**CO3**
	Section C	
Q.1	a) A 60 MVA Transformer has maximum efficiency of 99.9% (UPF) at 89% of load. If specific iron loss is 0.78 w/kg, find the weight of iron used for transformer. (7 Mark) b) Two identical transformers A & B are to be designed. Transformer A is designed with forced oil cooling and Transformer B is designed with Oil forced Water forced Cooling. In these cases, which transformer will have smaller (frame) dimensions? Why? (6 Marks) c) Find the percentage change in losses in a transformer, if a cruciform core transformer is proposed to redesign as redesigned as 3-step core. (8 Mark)	**CO2**
	OR	
Q.1	Obtain the frame dimensions for an ONAN cooled 250 kVA, Distribution transformer to be located in Delhi, having voltage rating of 11 kV/433 V. Take B_m as 1.6 wb/m^2, Current Density 3.2 a/m^2. Choose suitable number of steps for core and justify the choice. (Refer data as and where required)	**CO2**