

**Bachelor of Electrical Engineering, 2<sup>nd</sup> Year 2<sup>nd</sup> Semester Examination, 2017**

**SUBJECT: ELECTRICAL MACHINES-II**

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Time: Three Hours

Full Marks: 100 (50 each part)

**Use a separate Answer-Script for each part**

**PART - I**

**Answer any three questions. Question no.1 carries 18 marks.**

1. (i) Considering a hysteresis loop of core of a transformer made of iron, sketch the magnetizing current vs. time when the core flux vs. time is considered as a sinusoidal and show that current contains various harmonics. **6+6+6=18**
- (ii) What type of harmonics related problems may arise for Y-y without neutral wire connected core-type three phase transformer? How this problem can be mitigated?
- (iii) How Delta winding is used to overcome the problems of harmonics in a three phase transformer ?
2. (i) Draw and explain the connection diagrams and phasor diagrams of the following vector groups of three phase transformers. **9+7=16**
- a)  $Yz_{11}$  , b)  $Dz_0$  and c)  $Dd_6$
- (ii) What will happen if transformers vector groups  $Yd_1$  &  $Dy_{11}$  are paralleled as it is? Explain how a three phase  $Yd_1$  transformer can be successfully paralleled with a  $Dy_{11}$  transformer.
3. (i) Describe how a two phase system can be converted to a three phase system using Scott connection. **6+10=16**

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(ii) In Scott-connected transformers, the teaser transformer supplies a load of 40 kW with 0.75 p.f. (leading) at 220 V and the main transformer supplies a load of 50 kW with 0.85 p.f. (lagging) at 220 V in the secondary and the three phase input(primary) line voltage of the Scott is 6600V. Determine the input three phase line currents. Neglect magnetizing currents and the leakage impedance drops. Draw the input voltage and current phasors computed.

4. i) Discuss about the tapping strategy in a winding of a transformer considering position, insulation and current handling capability of the tap-changer. **8+8=16**

ii) Describe the operation of a tap-changer having center-tapped reactor. What are the advantages and disadvantages of a resistor type tap-changer ?

5. Write Short notes

**8 x 2 =16**

(i) Full wave and Chopped wave Impulse voltage tests on a transformer and detection of faults.

(ii) Comparison of a three phase transformer **bank** and a three phase core-type transformer **unit**.

## PART - II

Answer *any three* questions from this part.  
*Twomarks* are reserved for neat and well organised answer.

6. a) Starting from basic principle develop the expression for torque produced in a three phase induction motor. Establish the condition for maximum torque developed. Draw torque vs. slip characteristic and also show how torque vs. slip characteristic changes with variation of rotor resistance and rotor inductance. 10
- b) An 8 pole 50 Hz slip ring induction motor runs at slip of 2.67% on full load. The rotor resistance per phase of the winding is 0.2 ohm. What resistance per phase must be added to the rotor circuit to run the motor at a slip of 17.33% with the same torque? 6
7. a) Describe no-load and blocked rotor tests of an induction motor and show how to calculate the equivalent circuit parameters from these test results. 10
- b) The maximum torque of a 3-phase induction motor occurs at a slip of 12%. The motor has an equivalent secondary resistance of 0.08 ohm/phase. Calculate the equivalent load resistance  $R_L$ , the equivalent load voltage  $V_L$  and the current at this slip, if the gross power output is 9,000 watts. 6
8. a) Describe construction of a double squirrel cage induction motor and explain how starting torque is developed in a double cage induction motor. Draw the equivalent circuit of double cage rotor induction motor. 10
- b) The resistance and reactance (equivalent) values of a double cage induction motor for the stator, outer and inner cage are 0.25, 1.0 and 0.15 ohm of resistance while 3.5, zero and 3.0 ohm of reactance respectively. Find the starting torque if the phase voltage is 250 Volt and the synchronous speed is 1000 rpm. 6
9. a) What is the purpose of using deep-bar rotor? Explain the construction and working of a deep-bar rotor induction motor. 6
- b) A squirrel cage type induction motor when started by means of a star-delta starter takes 180% of full load line current and develops 35% of full load torque at starting. Calculate the starting torque and current in terms of full load values, if an auto-transformer with 75% tapping were employed. 6

10. a) Describe briefly the phenomenon of cogging and crawling. What measures can eliminate these effects? 6
- b) Explain the procedure of drawing the circle diagram of an induction motor. What information can be drawn from the circle diagram? 10