B. Tech - 3rd (EE/EEE)

Electrical Machines - I

Full Marks : 50

Time : 2 : 30 hours

Answer **all** questions.

The figures in the right-hand margin indicate marks.

Symbols carry usual meaning.

Any supplementary materials to be provided.

1. Answer *all* questions. 2 × 5

   (a) Why transformer rating is expressed in terms of kVA ?

   (b) Name of the various parts of a D.C. machine. Explain the construction of any one part.

(2)

(c) Define critical filed resistance and critical speed of a D.C. shunt generator.

(d) Why D.C. series motor should not be started at no load.

(e) Draw with relevant circuit and emf phasor diagram of a Yyo 3-phase transformer connection.

2. A 200 kVA, 1-phase transformer has an efficiency of 98% at full load. If the maximum efficiency occurs at $\frac{3}{4}$ full load, calculate the   8

    (i) Iron losses

    (ii) Copper losses at full load,

    (iii) Efficiency at half full load and

    (iv) Efficiency at 1/5 full load.

Assume a p.f of 0.8 at all loads.

(3)

Or

What is voltage regulation of a transformer ? Derive the conditions for maximum and zero voltage regulation in a transformer. Also derive expression for maximum efficiency of a 1-phase transformer and for load at maximum efficiency. 8

3. Explain the effect of armature reaction in a D.C. shunt generator. How are its demagnetizing and cross magnetizing ampere turn calculated.   8

Or

A 6-pole, 120kW, 500V, wave wound DC shunt generator has 756 armature conductors. The shunt filed resistance $50\,\Omega$ when delivering full load the brushes are displaced from the geometrical neutral axis by 24 electrical degrees. Find the demagnetizing ampere turns/pole and cross magnetizing ampere turns/pole. Also determine the number of additional shunt field turns required to neutralize the demagnetizing effect.   8

(Turn Over)

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(4)

4. A 230V DC shunt generator has a full load
   current of 150A. Its armature and field
   resistances are 0.1Ω and $230\,\Omega$ respectively.
   The stray losses are 1500W. Find the 8

   (i) Prime mover output in kW, when the
       generator is on full load,

   (ii) Full load efficiency, and

   (iii) load current at which generator effi-
        ciency is maximum.

   Or

   What is compound generator ? Draw the
   external characteristics of over, level and
   under compounded generators and explain. 8

5. A 200 V, DC series motor runs at 750 rpm
   when taking a current of 30 A. The resis-
   tance of the armature is $0.5\,\Omega$ and field is
   $0.3\,\Omega$. If the current remains constant,
   calculate the resistance necessary to reduce
   the speed to 250 rpm.   8

(5)

Or

   What are advantages of Hopkinson's
   test over Swinburne's test and what are it
   limit.   8

6. A 3-phase step-down transformer is
   connected to 6600V mains and it takes 20A.
   Calculate the secondary line voltage, line
   current and output for the following
   connections.   8

   (i) Y-Y

   (ii) $\Delta - \Delta$

   (iii) Y-Δ

   (iv) Δ-Y

   Turns ratio per phase is 10.

   Or

   Draw the Phasor diagrams and winding
   connection of three-phase transformer for : 8

   (i) Phase displacement of zero degrees

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(ii) Phase displacement of -30 degrees

(iii) Phase displacement of +30 degrees

(iv) Phase displacement of 180 degrees

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