3A2

Q(a) Conduct an experiment to find the terminal voltage of a **DC shunt generator** at 10%, 25% and 90% loading conditions (obtain these from a plot) at the rated speed. [Beyond available load, assume a linear characteristic]. Calculate the percentage voltage regulation. How much does this terminal voltage vary when the generator is run at 80% rated speed? If the armature resistance is given as 2.1 ohm, plot the **internal characteristics** for the 80% rated speed case. Consider the brush drop to be 2V. **[8+2+3+3]**

(b) Mention the types of DC generators and their applications in a tabular form. Also mention the expressions for the 2 types of voltage regulations. **[3+2]**

(c) i) A permanent magnet dc (PMDC) motor has an armature resistance of 1Ω. When fed from 48V dc source, it runs at a speed of 2400 rpm while taking 0.8A. Determine a) the no-load rotational losses of the motor b) the motor output when running at a speed of 1600 rpm and with a source voltage of 40V dc c) the stall torque when the source voltage is 20V dc.

ii) A 250V 10kW 1200 rpm dc shunt motor has a full load efficiency of 80 %. It has field and armature resistances of 110 Ω and 0.25 Ω respectively. Calculate the value of the resistance to be inserted in series with the armature and the power lost in the armature circuit to reduce the speed to 75% when a) the load is constant independent of speed b) the load torque is directly proportional to the speed c) the load torque varies as the square of the speed. **[5+5]**

2B1

Q(a) Conduct an experiment to find the percentage load corresponding to the given **single phase transformer** operating at 90% efficiency while operating at 0.7 lead pf. Determine theoretically the variation of efficiency with loading for the transformer and plot the values on a graph sheet. Also determine the loading at which the efficiency of the transformer is maximum and calculate the value of this efficiency. Obtain the equivalent circuit parameters of the transformer referred to the HV side and mention them on a properly labelled circuit diagram. Calculate the down and up voltage regulations while the transformer supplies 25 % load at 0.7 pf lead. **[8+2+2+3+3]**

(b) Sketch the variation of a) percentage voltage regulation vs load pf and b) efficiency vs load for different load pf. **[2]**

(c) i) A single phase load is fed through a 33 kV feeder whose impedance is 30+j120 Ω and a 33 kV /3.3 kV transformer of equivalent leakage impedance 0.3+j1.4 Ω referred to the lv side. For a load 100 kW at 0.8 pf leading at 3.3 kV terminals, compute the a) voltage at the sending end of the feeder b) active and reactive powers c) voltage at the primary of the transformer and d) power factor at the sending end of the feeder.

ii) The full load copper loss on the HV side of a 100 kVA, 11000/317 V, single phase transformer is 0.62 kW and on the LV side is 0.48 kW. Calculate the resistances of the LV and HV windings. If the total reactance is 4% find the reactances of the windings if they are in the same proportion to the resistances. **[6+4]**

1A3

Q(a) Conduct the experiment to find the **p.f and real power** in star and delta connected cases for the given **balanced** load at 50%, 75% and 90% of rated voltage conditions. For the star connected case prove that the real power drawn is independent of the **phase sequence** of the input supply. Draw the voltage and current waveform seen on power analyzer and measure the angle between two. Draw phasor diagrams for 3 phase balanced star and delta connected loads indicating clearly the angles and the various quantities.[**10+2+1+2]**

(b) Derive the expression of p.f. obtained from 2-wattmeter method considering a delta connected balanced load (mention the phase sequence). [**5]**

(c) i) A 3 phase 500 kW 3.3 kV 50 Hz star connected induction motor works at a full load power factor of 0.7 lag. A delta connected capacitor bank is used to raise the full load power factor to 0.9 lag. Calculate the capacitance of the bank. If each capacitor is rated at 420V 50 Hz compute the capacitance of each unit. The motor efficiency is 86%. If this machine is fed by a distribution network, calculate the percentage saving in the energy lost in the network as the power factor is improved from 0.7 to 0.9 lag. If two wattmeters are connected across the motor terminals find the sum of their readings for the fully loaded case with and without pf improvement.

ii) Two wattmeters are connected to measure power in a 3 phase network. The two readings are 2000W and 1000W respectively. If another wattmeter is connected such that its current coil is in one phase and the potential coil is across the other two phase terminals, what will it read? Also estimate the reactive power of the network. [**6+4]**