A 12 kW, 100 V, 1000 rpm dc shunt generator has armature resistance $R_a = 0.1\ \Omega$, shunt field winding resistance $R_{fw} = 80\ \Omega$, and $N_f = 1200$ turns per pole. The rated field current is 1 ampere. The magnetization characteristic at 1000 rpm is shown in Fig. 4.24.

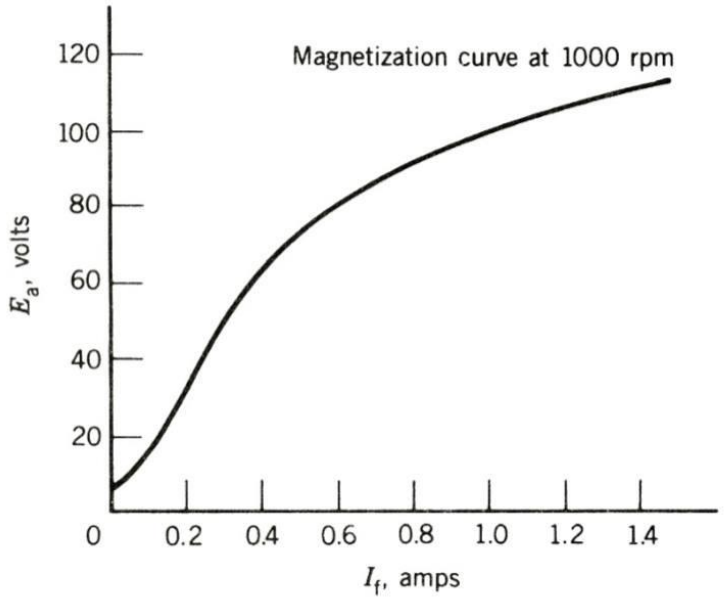
The machine is operated as a separately excited dc generator at 1000 rpm with rated field current.

(a) Neglect the armature reaction effect. Determine the terminal voltage at full load.

(b) Consider that armature reaction at full load is equivalent to 0.06 field amperes.

(i) Determine the full-load terminal voltage.

(ii) Determine the field current required to make the terminal voltage $V_t = 100$ V at full-load condition.



A four-pole dc machine has an armature of radius 12.5 cm and an effective length of 25 cm. The poles cover 75% of the armature periphery. The armature winding consists of 33 coils, each coil having seven turns. The coils are accommodated in 33 slots. The average flux density under each pole is 0.75 T.

1. If the armature is lap-wound,
   - **(a)** Determine the armature constant K_a.
   - **(b)** Determine the induced armature voltage when the armature rotates at 1000 rpm.
   - **(c)** Determine the current in the coil and the electromagnetic torque developed when the armature current is 400 A.
   - **(d)** Determine the power developed by the armature.
2. If the armature is wave-wound, repeat parts (a) to (d) above. The current rating of the coils remains the same as in the lap-wound armature.

A 10 kW, 100 V, 1000 rpm dc machine has $R_a = 0.1\ \Omega$ and is connected to a 100 V dc supply.

- **(a)** Determine the starting current if no starting resistance is used in the armature circuit.
- **(b)** Determine the value of the starting resistance if the starting current is limited to twice the rated current.

A variable-speed drive system uses a dc motor that is supplied from a variable-voltage source. The torque and power profiles are shown in Fig. 4.53*d*. The drive speed is varied from 0 to 1500 rpm (base speed) by varying the terminal voltage from 0 to 500 V with the field current maintained constant.

- **(a)** Determine the motor armature current if the torque is held constant at 300 N · m up to the base speed.
- **(b)** The speed beyond the base speed is obtained by field weakening while the armature voltage is held constant at 500 V. Determine the torque available at a speed of 3000 rpm if the armature current is held constant at the value obtained in part (a).

  Neglect all losses.