Course Title: Electrical Machines I

Course Code: EE321

Sheet 1

E.M.F. Equation

1. A 4 pole lap-connected armature has 360 armature conductors, a flux of 0.08 Wb/pole and a speed of 600 rpm. Calculate the e.m.f. generated on open circuit. What will be the e.m.f generated if the machine is wave-connected and is driven at a speed of 400 rpm?

2. The armature of a 4 pole dc shunt generator is lap wound and generates 216 V when running at 600 rpm. Armature has 144 slots, with 6 conductors per slot. If this armature is rewound, wave-connected, find the e.m.f generated with the same flux per pole but running at 500 rpm.

3. When driven at 1000 rpm with a flux per pole of 0.02 Wb, a dc generator has an e.m.f of 200 V. If the speed is increased to 1100 rpm and at the same time the flux per pole is reduced to 0.019 Wb/pole. What is the generated e.m.f?

4. A 4 pole lap-wound dc shunt generator having 80 slots with 10 conductors per slot generates at no-load an e.m.f of 400 V, when run at 1000 rpm. How will you obtain a generated open-circuit voltage of 220 V?

Example 26.21(c). *A four-pole lap-wound dc shunt generator having 80 slots with 10 conductors per slot generates at no-load an e.m.f. of 400 V, when run at 1000 rpm. How will you obtain a generated open-circuit voltage of 220 V ?* **(Nagpur University November 1996)**

Solution. (*i*) Keeping operating speed at 1000 rpm only, **change the flux per pole**

The O.C. e.m.f. is given by $E = (\phi ZN/60) \times (P/a)$

For the given operating conditions,

$$400 = \phi \times (80 \times 10) \times (1000/60) \times (4/4)$$

which gives $\phi = 30$ mWb

When speed is kept constant at 1000 rpm only,

$$E \propto \phi$$

Or to get 220 V on O.C., $\phi_2 = (220/400) \times 30 \text{ mWb} = 16.5 \text{ mWb}$

Thus, by increasing the shunt-field-circuit resistance with the help of adding external rheostatic, the current in the field-circuit is decreased so as to decrease the flux to 16.5 mWb.

(*ii*) Keep same flux per pole, change the speed.

If ϕ is held constant at 30 mWb, an O.C. e.m.f. of 220 V is obtained at a speed of N r.p.m., given by

$$220 = 30 \times 10^{-3} \times 800 \times N/60, \; N = 550 \text{ rpm}$$

At 220 V, the flux can be maintained at 30 mWb provided the field **current is unchanged.**

$$400/R_{f1} = 200/R_{f2}$$

or $R_{f2} = 0.55 \, R_{f1}$

Thus, the field circuit resistance must be reduced to the new value of 0.55 R_{f1} in order to obtain 30 mWb of flux per pole from a voltage of 220 V.

(*iii*) Any other combination of proper speed and flux/pole can be chosen and worked out on similar lines.