

Answer the following questions:

**First Question(6+9Marks)**

Q1) Write on the following:-

- Briefly describe the difference between renewable and non-renewable energy sources, with examples.
- Construct a chart to compare the advantages and disadvantages of fossil fuels, hydro-electricity, and nuclear power.

**Second Question(9+8+3Marks)**

Q2)

As shown in Fig.1, a magnetic circuit consists of a core of high permeability ( $\mu=\infty$ ), an air gap length  $g$ , and a section of magnetic material of length  $L_m$ . Calculate the flux density  $B_g$  in the air gap if the magnetic material is

- Alnico 5 and
- M-5 electrical steel.

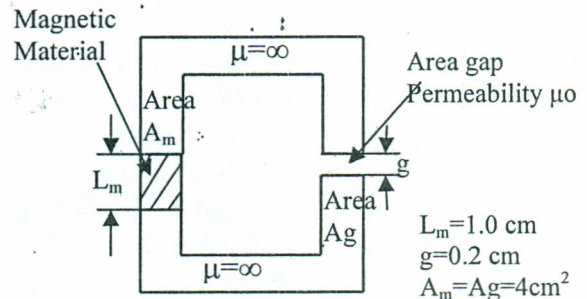


Fig.1

Where the BH curves for the used magnetic materials are as follow:-

Alnico5	B (Tesla)	1.2	1	0
	H(KA/m)	0	-38	-50
M-5	B (Tesla)	1.4	0.75	0
	H(KA/m)	0	-5	-6.5

- Comment on results.

**Third Question(8+7 Marks)**

Q3)

The magnetic circuit shown in Fig.2 is made of cast steel. The rotor is free to run about a vertical axis. The dimensions are shown in the Figure.

- Drive an expression in SI units for the torque acting on the rotor in terms of the dimensions and the magnetic field in the two air gaps: Neglect the effects of fringing.
- The maximum flux density in the overlapping portions of the air gaps is limited to approximately 2 Tesla, because of saturation in the steel. Compute the maximum torque in newton-meters for  $r_1=2\text{cm}$ ,  $h=2\text{cm}$  and  $g=0.2\text{cm}$ .

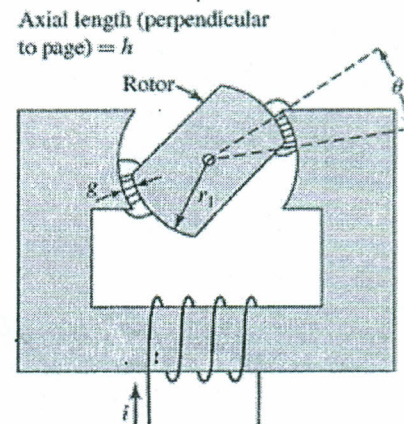


Fig.2

### Fourth Question(5+5+5 Marks)

Q4)

- a) List the faults which can be occurred in the electrical network.
- b) What is the main and back-up protection?
- c) Discuss the types and the effects of the faults in the synchronous generator.

### Fifth Question(7+8 Marks)

Q5)

- a) List the protection methods for the electrical transformer.
- b) Explain in details the function of the Buchholz Relay.

### Sixth Question(20 Marks)

Q6)

Figure 3 shows in cross section a cylindrical solenoid magnet in which the cylindrical plunger of mass  $M$  moves vertically in brass guide rings of thickness  $g$  and mean diameter  $d$ .

The permeability of brass is the same as that of free space and is  $\mu_0 = 4\pi \times 10^{-7}$  H/m in SI units. The plunger is supported by a spring whose spring constant is  $K$ . Its unstretched length is  $L_0$ . A mechanical load force  $f_t$  is applied to the plunger from the mechanical system connected to it, as shown in Fig. 3. Assume that frictional force is linearly proportional to the velocity and that the coefficient of friction is  $B$ . The coil has  $N$  turns and resistance  $R$ . Its terminal voltage is  $v_t$  and its current is  $i$ . The effects of magnetic leakage and reluctance of the steel are negligible.

**Derive** the dynamic equations of motion of the electromechanical system, i.e., the differential equations expressing the dependent variables  $i$  and  $x$  in terms of  $v_t$ ,  $f_t$ , and the given constants and dimensions.

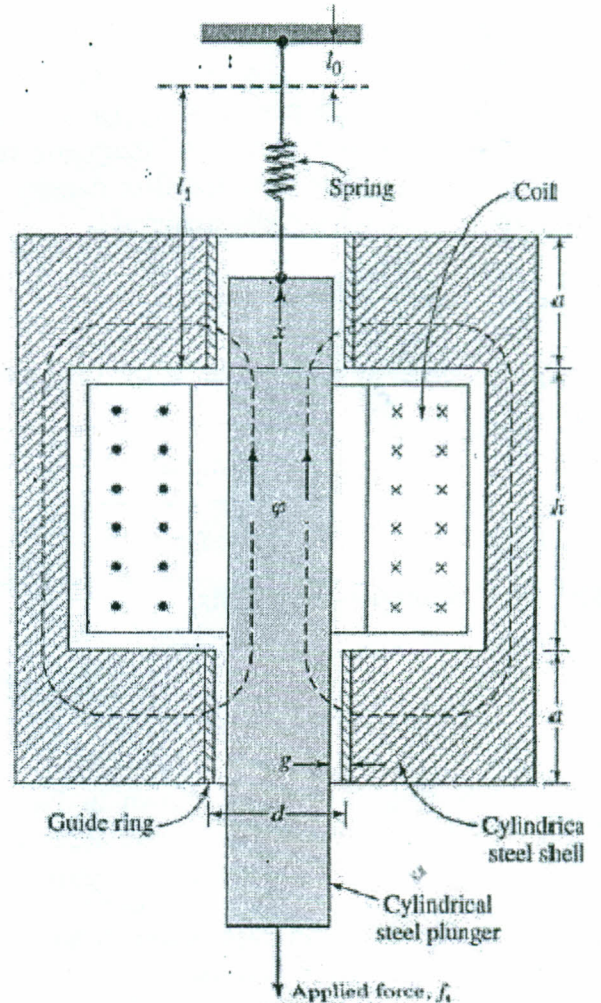


Fig.3

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