- High ductility, so that can be drawn in the form of wire easily.
- High corrosion resistance mean free from oxidation.
- Low cost.
- Long life or durable.
- High flexibility.

2(c) Properties of Platinum

- Physically, platinum is a soft, lustrous, silver-coloured metal.
- It is highly dense (21.5 g/cc), malleable and ductile (there is an ongoing debate if it is the most ductile).
- It is also highly corrosion resistant and has a high boiling point (around 1700 degrees Celsius or 3220 degrees Fahrenheit).
- Chemically, platinum is one of the most stable elements in nature. It is often referred to as Noble metal because of its high stability.
- It is immune to nitric and hydrochloric acids but can be dissolved by aqua regia at a high temperature.
- It reacts with oxygen and fluorine but at very high temperatures.

Uses of Platinum

- It is used in laboratories for electrodes.
- Optical fibres, wires, and pacemakers also make use of platinum for better efficiency.
- Certain compounds of platinum are used in chemotherapy for treating cancer.
- Some watchmakers use platinum in their watches to make them exclusive.

PNS School of Engineering & Technology

Nishamani Vihar, Marshaghai, Kendrapara

Internal Assessment Examination-2022(5th Semester)

Subject : Th-2 -Energy Conversion-II

Branch : Electrical Engineering

Time : $1\frac{1}{2}$ Hours F.M. : 20

1. Answer the following questions (any Five). [2 x 5]

   (a) Calculate the frequency of voltage generated by an alternator having 4 poles and rotating at 1800 r.p.m.

   (b) Define pitch factor or coil span factor.

   (c) How hunting in an alternator can be reduced ?

   (d) Calculate the distribution factor for a 36 slots, 4 pole, single layer, 3ϕ winding.

   (e) Define votage regulation of an alternator.

   (f) Write any two advantages of parallel operation of alternators.

2. Answer the following questions. (any Two) [5 x 2]

   (a) A 3ϕ, 16 pole alternator has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 wb sinusoidally distributed and speed is 375 rpm. Find the phase and line value of generated emf. Assume the coils are full pitched.

   (b) Draw the vector diagram of a loaded alternator for an inductive load and find the expression for no load generated emf.

   (c) A60KVA, 220V, 50Hz, 1ϕ alternator has an effective armature resistance of 0.016 ohm and an armature leakage reactance of 0.07ohm. Compute the voltage induced in the armature when the alternator is delivering rated current at a load power factor of (a) Unity (b) 0.7 leading.

❖❖❖

ANSWER

1(a) Speed N = 1800 rpm

No. of poles = 4

As $N = 120f / P$

$f = NP / 120 = 1800*4 / 120 = 60$ Hz

1(b) Pitch factor the ratio of the voltage induced in a short-pitch winding to the voltage that would be induced if the winding were full pitch.

1(c) Hunting may be reduced by using damper windings.

1(d) No. of poles, P = 4

No. of slots = 36

No. of phases = 3

No. of slots/pole, $n = \frac{36}{4} = 9$

No. of slots/pole/phase, $m = \frac{36}{4*3} = 3$

$\beta = \frac{180}{9} = 20$

Distribution factor, $K_d = \frac{\sin m\beta/2}{m \sin \beta/2} = \frac{\sin 30}{3 \sin 10} = 0.96$

1(e) The voltage regulation of an alternator is defined as the change in the terminal voltage of the generator on the application of load when the speed and the field current(excitation) remain constant with respect to terminal voltage.

1(f) Two advantage of parallel operation of alternators are

- Size of the alternator will be reduced.
- Repair and maintenance of alternator will be easy.

2(a) No. of poles, P = 16

Speed, Ns = 375 rpm

Flux, $\Phi = 0.03$ Wb

No. of slots = 144

No. of conductors/slot = 10

No. of phases = 3

No. of slots/pole, $n = \frac{144}{16} = 9$

No. of slots/pole/phase, $m = \frac{144}{16*3} = 3$

$\beta = \frac{180}{9} = 20$

Distribution factor, $K_d = \frac{\sin m\beta/2}{m \sin \beta/2} = \frac{\sin 30}{3 \sin 10} = 0.96$

For full pitch winding,

Coil span factor, $K_c = 1$

Supply frequency, $f = \frac{PN}{120} = \frac{16*375}{120} = 50$ Hz

Conductor/ phase = $\frac{144*10}{3}$ = 480

Emf induced per phase, E_{ph} = $2.22\ K_c\ K_d f\ \Phi\ Z_{ph}$ Volts

= 2.22*1*0.96*480*50*0.03 = 1534 Volts

2(b) For inductive load (lagging p.f.):

Considering Fig. given below

from the right angle triangle ODC,

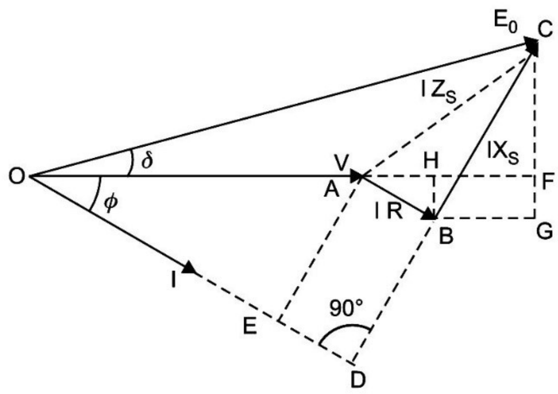
we get, $OC^2 = OD^2 + DC^2$

or $OC^2 = (OE + ED)^2 + (DB + BC)^2$

or $OC^2 = (OE + AB)^2 + (EA + BC)^2$

or $E_0^2 = (V\cos\Phi + IR)^2 + (V\sin\Phi + IXs)^2$

or $E_0 = \sqrt{(V\cos\Phi + IR)^2 + (V\sin\Phi - IX_S)^2}$



Phasor diagram for lagging pf

2(c) Rated power = 60 kVA = 60 × 10^3 VA

Terminal voltage, V = 220 V

Armature resistance, R_a = 0·016 ohm; Leakage reactance, X_L = 0·07 ohm

Rated current, I = $\frac{60000}{220}$ = 272.72 A

When the p.f., cos Φ = 1; sin Φ = 0

Induced emf $E_0 = \sqrt{(V + I_aR_a)^2 + (I_aX_L)^2} = \sqrt{(220 + 4.3)^2 + (19)^2}$ = 225 V

When the p.f., cos Φ = 0.7 Lead; sin Φ = 0.7

Induced emf $E_0 = \sqrt{(V\cos\Phi + I_aR_a)^2 + (V\sin\Phi - I_aX_L)^2}$

$= \sqrt{(220*0.7 + 4.3)^2 + (220*0.7 - 19)^2}$ = 208 V