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آلات كهربائية

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لجنة



Polytechnic

م. ضولة

١٠/١٠/١١

Al-Balqa Applied University

Faculty of Engineering Technology

Electrical Machine

9
20

First exam

23/6/2013

Name:

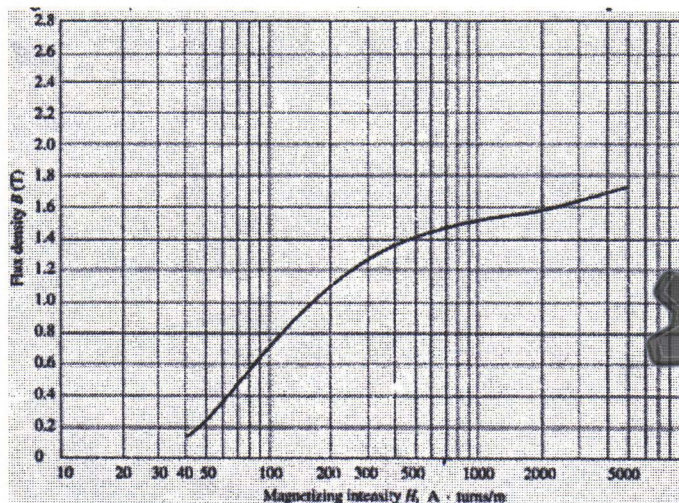
Q1) Fill in the space the correct answer:

- 1) ~~Coils~~ provide the mmf for the main working flux.
- 2) To reduce the eddy current losses ~~change in current~~
- 3) ~~increase area of stator~~ reduce the reluctance of the air gap.
- 4) provide the mmf for the main working flux.
- 5) Reduce the reluctance of the air gap.
- 6) ~~poles are skewed~~ are skewed sometimes to reduce noise. (~~brushes of carbon~~)
- 7) ~~air gap~~ the space between stator and rotor.
- 8) The two criteria's that occur when the machine work as generator or as motor are:
 - a) ~~when current passes through conductor~~ there are magnetic field generator around it.
 - b) ~~when magnetic field passes through conductor~~ there are current happen in conductor and voltage

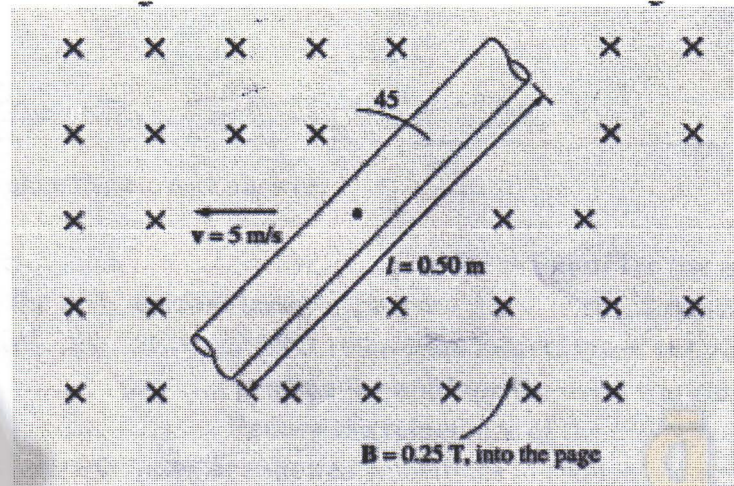
Q2) A transformer core with an effective mean path length of 10 m has a 300-turn coil wrapped around one leg. Its cross-sectional area is 0.25 m^2 , and its magnetization curve is shown in the Figure. If current of 0.25 A is flowing in the coil, what is the total flux in the core? What is the flux density?

$$L = 10 \text{ cm} \quad N = 300 \quad A = 0.25 \text{ cm}^3$$

$$I = 0.25 \text{ A}$$



Q3) The wire is shown in the Figure below is moving in the presence of a magnetic field. With the information given in the figure, determine the magnitude and direction of the induced voltage in the wire.



$$\mathcal{E} = BVL = (0.25)(5)(0.5) = 0.625 \text{ V}$$

The direction is vertically



Q1): A 22KVA, 2200/220 V, single phase transformer has a maximum efficiency when it delivers primary load current (I_1) is 9 A at power factor (PF) 0.85 lagging. If the $R_{sc1} = 6\Omega$. Determine:-

- The magnetic losses and electrical losses at full load. (3 marks)
- The maximum efficiency of the transformer at 0.85 PF lag. (2 marks)
- The efficiency of the transformer when it delivers full load at 0.9 power factor lagging. (2 marks) $\beta = 1$

Q2): A 50KVA, 2500/250 V, single phase transformer. The short-circuit test was performed on the primary side of the transformer, and the following data were recorded:-

$V_{sc} = 90\text{ V}$; $I_{sc} = 18\text{ A}$; $P_{sc} = 972\text{ watt}$.

determine the voltage regulation of the transformer when it delivers 0.8 full load at 0.9 power factor lagging. (5 marks).

- Drive the electromotive force equation (E_1) of the ideal transformer at no-load case. (3 marks).

Q3): A 10 Poles, DC machine which has a wave-winding armature. The generated electromotive force (E_A) and the armature current (I_A) in this machine are 420V, 80 A, respectively and the machine run at speed of 1800 RPM,. If the armature winding redesigned as lap-winding, what are the magnitude of E_A and I_A .

- find the electromagnetic power and electromagnetic torque. (6 marks)

$= 50\text{ KVA}$
 $= 2500\text{V}, V_{2FL} = 250\text{V}$

Dr. Omar Barbarawi

$I_{1FL} = \frac{S_n}{V_{1FL}} = \frac{50\text{ KVA}}{2500\text{ V}} = 20\text{ A}$
 $R_{eq} = \frac{P_{sc}}{I_{sc}^2} = \frac{972}{18^2} = 3\Omega$, $Z_{sc} = \frac{V_{sc}}{I_{sc}} = \frac{90}{18} = 5\Omega$
 $X_{eq} = \sqrt{5^2 - 3^2} = 4\Omega$, $\beta = 0.8$, $\phi = \cos^{-1} \text{PF} = -25.84^\circ$
 $V_{1NL} = V_{1FL} \angle 0^\circ + \beta I_{1FL} R_{eq} \angle \phi + j \beta I_{1FL} X_{eq} \angle \phi$

$V_R = \frac{V_{1NL} - V_{1FL}}{V_{1FL}}$

GOOD LUCK

* First exam :- Q3)-

$$E_A = K \phi \omega = \frac{N P \phi}{2 \pi a} \frac{2 \pi n}{60}$$

$$E_A = \frac{N P \phi n}{60 a} \Rightarrow 420 = \frac{N P \phi n}{120}$$

$$N P \phi n = 50400$$

$$I_A = 2 I_c \Rightarrow 80 = 2 I_c \Rightarrow I_c = 40 A$$

for Lap-winding :- $a = b$

$$a) \quad E_A = \frac{N P \phi n}{60 a} = \frac{50400}{(60)(10)} = \boxed{84 V}$$

$$I_A = a I_c = (10)(40) = \boxed{400 A}$$

$$b) \quad P_{em} (wave) = P_{em} (Lap)$$

$$P_{em} = E_A I_A = 420 \times 80 = \boxed{33.6 kW}$$

$$T_{em} (wave) = T_{em} (Lap)$$

$$\frac{N \phi (80)(10)}{4 \pi} = \frac{N \phi (400)(10)}{20 \pi}$$

$$T_{em} = \boxed{63.66 N.m}$$



AL-BALQA APPLIED UNIVERSITY

FACULTY OF ENGINEERING TECHNOLOGY

Electrical Machines 1

First Exam.

Q1: A single-phase power transformer of 630 kVA has 5 kW magnetic losses and 9 kW rated electrical losses. It was operated 6 hours at no-load, 10 hours at half load with P.F. = 0,85 and 90% efficiency, and 8 hours at quarter load with P.F. = 0,8 and 60% efficiency. Find the daily efficiency of this transformer.

Q2: A single phase power transformer of 120 kVA has the efficiency of 96% at P.F. = 0,95 and 0,9 of full load .If the magnetic losses at rated voltage are 1,5 kW find:

1. The electric losses at full load,
2. At what load we obtain the max. Efficiency,
3. The max. Efficiency at $P_f = 0,85$



Q3: Using the transformer equivalent circuit and the necessary equations draw the Phasor diagram of currents and voltages for load lagging power factor.

Q4: A 280-turn winding on a laminated magnetic-steel core is excited by a 50 Hz Sinosoidal source of 240 V (rms). Neglecting the resistance of the winding and the leakage flux, find the max. Flux density in the core if the uniform cross-sectional area of the core is 5cmX5cm.

Dr. Sultan Goussouse

Dr. Omar Barbarawe



Faculty of engineering technology

Electrical machines

second exam

5/12/2012

(3-hours)

Q1) A 20 kw, 250V, 1800RPM, shunt DC motor has the following parameters;-
 $R_A = 0.2 \Omega$, $R_{sh} + R_{adj} = 100 \Omega$. At no-load the motor runs at **1800RPM** and the armature takes current equal **5 A**.

Find:- a) The starting current and the starting torque. (2-marks)

b) At 0.7 full load find the speed, the electromagnetic torque and the efficiency. (4-

c) Find the speed of the motor if magnetic flux decreased by 20% (with const. EA) (2-

d) What would be the speed of the motor if the field coil circuit disconnected from the power supply when the motor working at no-load. (2-marks)

Q2) A 50 Kw, 250V, 1800RPM, long-shunt (compound) DC generator has the following parameters;- $R_A = 0.15 \Omega$, $R_{se} = 0.05 \Omega$, $R_{sh} + R_{adj} = 125 \Omega$. rotational losses are **500 watt**. At **0.8 full-load**

Find :- The electromagnetic torque, the applied torque and the efficiency. (4-marks)

b) Find the new generated voltage (EA) if the magnetic flux decreased by 20% (with constant speed of the generator) (2-marks)

Q3): a) State the starting methods of the shunt DC motors (2-marks)

b) Draw and briefly explain the load (terminal) characteristic of a shunt DC generator. (2-marks)



Second exam :- Q1)-

shunt DC motor

$$a) I_{st} = \frac{V_T}{R_A} = \frac{250}{0.2} = \boxed{1250 \text{ A}}$$



$$b) P_{in} = V_T I_L \Rightarrow I_L = \frac{P_{in}}{V_T} = \frac{20000}{250} = 80 \text{ A} = I_{FL}$$

$$I_{sh} = \frac{V_T}{R_{sh} + R_{adj}} = \frac{250}{100} = 2.5 \text{ A}$$

$$I_L = I_A + I_{sh}$$

$$80 = I_{AFL} + 2.5 \Rightarrow I_{AFL} = 77.5 \text{ A}$$

$$56 = I_{0.7FL} + 2.5 \Rightarrow I_{0.7FL} = 53.5 \text{ A}$$

$$V_T = E_A + I_A R_A$$

$$250 = E_A + 77.5(0.2) \Rightarrow E_{AFL} = 172.5 \text{ V}$$

$$250 = E_A + 53.5(0.2) \Rightarrow E_{A0.7FL} = 196.5 \text{ V}$$

$$\frac{E_{AFL}}{E_{A0.7FL}} = \frac{n_{FL}}{n_{0.7FL}} \Rightarrow \frac{172.5}{196.5} = \frac{1800}{n_{0.7FL}}$$

$$n_{0.7FL} = \boxed{2050 \text{ RPM}}$$

$$T_{em} = \frac{P_{em}}{\omega_m} = \frac{E_A I_A}{\omega_m} = \frac{196.5 * 53.5}{\frac{2\pi * 1800}{60}} = \boxed{55.77 \text{ N.m}}$$

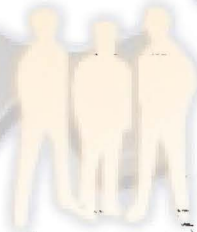
$$\eta = \frac{P_{out}}{P_{in}} = \frac{P_{em} - P_{rot}}{20000}$$

=



Q what would be the speed of the motor if the field coil circuit disconnected from ~~from~~ the Power supply at no-load ?

يصبح لدينا ϕ_{Rez} ، أي إذا انفصلت ملفات المجال أثناء عمل المحرك فإنه السرعة تصل إلى سرعة لانهاية لأنه المجال يكون قليل جداً نأجم عن بقايا مغناطيسية .



Polytechnic



Q2)- $T_{em} = \frac{E_A \cdot I_A}{\omega}$

long shunt (compound)
DC generator

$$I_A = I_L + I_{sh}$$

$$I_{sh} = \frac{V_T}{R_{sh} + R_{adj}} = \frac{250}{125} = 2 \text{ A}$$

$$I_L = \frac{P_{out}}{V_T} = \frac{50000}{250} = 200 \text{ A}, \quad I_{0.8Fl} = 200 \times 0.8 = 160 \text{ A}$$

$$I_A = 202$$

$$V_T = E_A - I_A (R_A + R_{se})$$

$$250 = E_A - 202(0.15 + 0.05) \Rightarrow E_A = 290.4 \text{ V}$$

$$T_{em} = \frac{290.4 \times 202}{\frac{2\pi \times 1800}{60}} = 311.2 \text{ N.m}$$

$$T_{applied} = \frac{P_{in}}{\omega_m}$$

$$P_{in} = P_{em} + P_{rot+losses}, \quad P_{rot} = T_{nl} \omega_{nl}$$

$$P_{em} = E_A I_A = 290.4 \times 202 = 58660.8 \text{ W}$$

$$P_{in} = 58660.8 + 500 = 59160.8 \text{ W}$$

$$T_{app} = \frac{59160.8}{\frac{2\pi \times 1800}{60}} = 313.8 \text{ N.m}$$

$$\eta = \frac{P_{out}}{P_{in}} = \frac{50000}{59160.8} = 84.5\%$$



⑥ magnetic flux decreased by 20% \Rightarrow at 0.8 FL

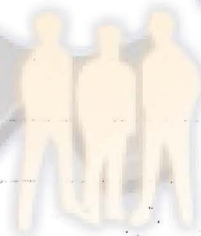
$$I_L = 200 \text{ A}$$

$$I_{0.8FL} = I_L \times 0.8 = 200 \times 0.8 = 160 \text{ A}$$

$$I_A = I_{0.8FL} + I_{sh} = 160 + 2.4 = 162.4 \text{ A}$$

$$E_A = V_T + I_A(R_A + R_{se})$$

$$= 250 + 162.4(0.15 + 0.05) = \boxed{282.4 \text{ V}}$$



Polytechnic



Al-Balqa' Applied University

Faculty of Engineering Technology

Power Engineering Dept.

Instructor: Dr Mohammed Al_Soud



Electrical Machines

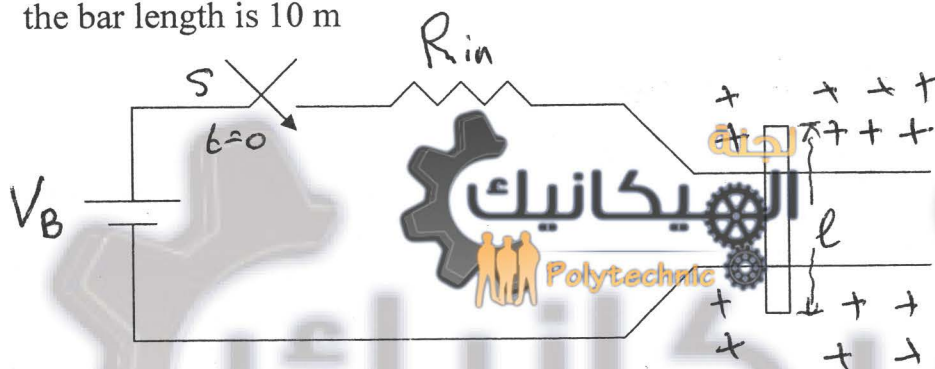
3 Class Hours

Second Exam/ 20 Point

CHOOSE THE CORRECT ANSWER AND WRITE IT IN THE ANSWER BOX

BART A

For the linear dc machine shown in fig, if the battery voltage is 120 V, an internal resistance of 0.3 ohm, the magnetic flux density of 0.1 T directed into the page, and the bar length is 10 m



1- The steady state velocity at no-load is

- ☒ A) 120 m/s B) 240 m/s
C) 80 m/s D) 180 m/s

2- If 30-N force is applied to the right to the bar. The induced voltage on the bar must be

- A) 125 V B) 115 V
☒ C) 129 V D) 139 V

3- If 30-N force is applied to the right to the bar. The new steady state speed is

- A) 125 m/s ☒ B) 129 m/s
C) 135 m/s D) 139 m/s

4- If 30-N force is applied to the left to the bar. The induced voltage on the bar must be

- A) 125 V B) 115 V
☒ C) 111 V D) 121 V

5- If 30-N force is applied to the left to the bar. The new steady state speed is

- ☒ A) 125 m/s B) 150 m/s
C) 175 m/s D) 200 m/s

سأنتبه لاسأل خطأ

111



BART B

6- The function of the commutator in a d. c machine is

- A) To change alternating current to direct current
- ☒ B) To change alternating voltage to direct voltage
- C) To change alternating current to direct voltage
- D) To change alternating voltage to direct current

7- A shunt dc generator driven at normal speed in the normal direction fails to build up armature voltage because

- A) The armature resistance is high
- B) The field current is not sufficiently high
- ☒ C) There is no residual magnetism.
- D) a + b

8- For the flat compounded dc generator

- A) The full-load terminal voltage is less than the no-load terminal voltage
- ☒ B) The full-load terminal voltage is more than the no-load terminal voltage
- ☒ C) The full-load terminal voltage is equal the no-load terminal voltage
- D) The full-load terminal voltage is less than the induced voltage

9- The terminal characteristic of separately excited dc motor is look

- A) Like series dc motor
- ☒ B) Like shun dc motor
- C) Slightly more than cumulatively dc motor
- D) Like series dc generator

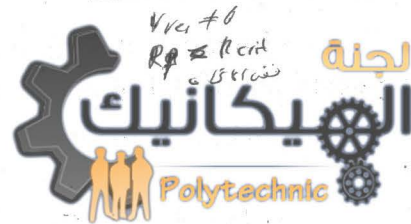
10- What would happen if the field of dc shunt motors is opened while it's running?

- A) The speed of the motor will be reduced
- ☒ B) The motor will destroy itself.
- C) It will run at its normal speed
- D) It will be stopped

ANSWER BOX

1	2	3	4	5	6	7	8	9	10
A	C	B	C	A	A	D	E	B	B

Handwritten notes and checkmarks below the answer box table.



Al-Balqa' Applied University

Faculty of Engineering Technology

Power Engineering Dept.

Instructor: Dr Mohammed Al_Soud



Electrical Machines

3 Class Hours

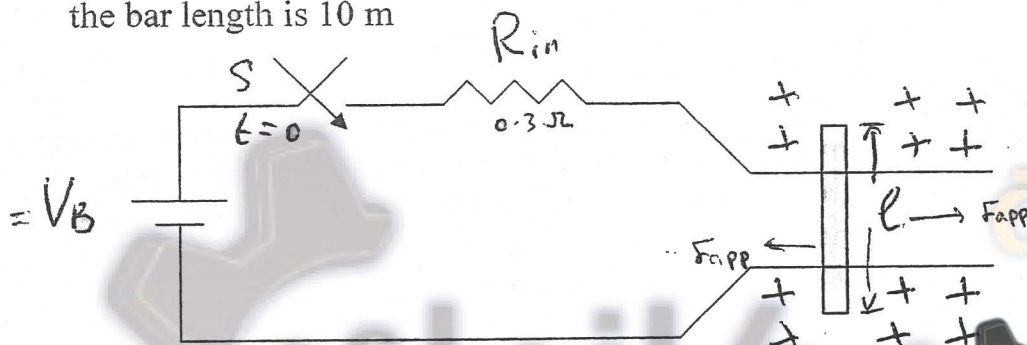
Second Exam/ 20 Point

حصة 20 نقطة / 3 ساعات دراسية

CHOOSE THE CORRECT ANSWER AND WRITE IT IN THE ANSWER BOX

BART A

For the linear dc machine shown in fig, if the battery voltage is 120 V, an internal resistance of 0.3 ohm, the magnetic flux density of 0.1 T directed into the page, and the bar length is 10 m



1- The steady state velocity at no-load is

- A) 140 m/s B) 130 m/s
☒ C) 120 m/s D) 110 m/s

2- If 30-N force is applied to the right to the bar. The induced voltage on the bar must be

- A) 125 V B) 115 V
☒ C) 129 V D) 139 V

3- If 30-N force is applied to the right to the bar. The new steady state speed is

- A) 119 m/s ☒ B) 129 m/s
 C) 139 m/s D) 149 m/s

4- If 30-N force is applied to the left to the bar. The induced voltage on the bar must be

- ☒ A) 111 V B) 121 V
 C) 131 V D) 141 V

5- If 30-N force is applied to the left to the bar. The new steady state speed is

- A) 130 m/s B) 140 m/s
 C) 150 m/s D) 160 m/s

other/s



BART B

- 6- The function of the commutator in a d. c machine is
- A) To change alternating voltage to direct current
 - B) To change alternating current to direct voltage
 - ☒ C) To change alternating voltage to direct voltage
 - D) To change alternating current to direct current
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- A) The full-load terminal voltage is more than the no-load terminal voltage
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- 9 - The terminal characteristic of separately excited dc motor is look
- A) Like series dc motor
 - ☒ B) Like shunt dc motor
 - C) Like cumulatively dc motor
 - D) Like shunt dc generator
- 10- What would happen if the field of dc shunt motors is opened while it's running?
- A) It will be stopped
 - B) It will run at its normal speed
 - C) The speed of the motor will be reduced
 - ☒ D) The motor will destroy itself.



ANSWER BOX

1	2	3	4	5	6	7	8	9	10
C	C	B	A	Others	C	D	B	B	D
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



13+1
20

AL-Balqa'a Applied University.
Faculty of Engineering technology.

Electric Machine.
(Second Exam).

Name: ~

م. خوة

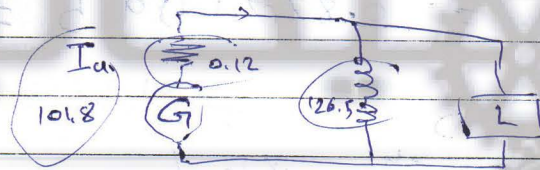
١٠١٠ - ١١

Q1) For rotor that has Lap windings for shunt dc generator, gives (101.8 A), rotate in velocity (1000 turn/minute) in magnetic field (0.02 wb).

Resistance coils for the rotor is 0.12Ω , & the resistance coils for field is 126.5Ω . If iron & mechanical losses are 877 watt, ignore A.R. Find:-

- 1) E_a ($k = 720$).
- 2) I_f .
- 3) I_L
- 4) P_L
- 5) P_{cu}
- 6) $\eta\%$.

11



$$[1] E_e = K \Phi \omega_n$$

$$= (720) (0.02) \left(\frac{2\pi}{60} \right) (1000) = 1507.2 [V]$$

$$[2] V_L = E_a + I_a R_a$$

$$= 1507.2 + (101.8)(0.12) = 1519.4 [V]$$

$$V_L = V_f = I_f R_f$$

$$I_f = \frac{1519.4}{126.5} = 12 [A]$$

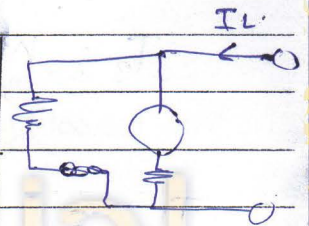


Q2) DC shunt Motor (1000 r.p.m, 100 V, 12 kW) supply from dc voltage (100 V), Resistance for rotor field is 0.1 Ω , Resistance for coil field is 80 Ω , R_F
For no load: ω_s 1000 turn/minute.

$$I_a = 6 \text{ A}$$

magnetization curve is given by (1000 turn/minute):

$I_f \text{ (A)}$	0	0.2	0.4	0.6	0.83	0.86	0.99	1.2	1.32	1.4
E_{acv}	8.5	31.4	65	77.1	93.5	94.4	99.4	108.5	110	114.2



Find:

- 1) the control resistance in field (R_{fc}).
- 2) the velocity, mechanical Torque For Full Load :-
 - a) without A.R.
 - b) if Φ is decreased 5%.

$$\textcircled{1} V_L = E_a + I_a R_a$$

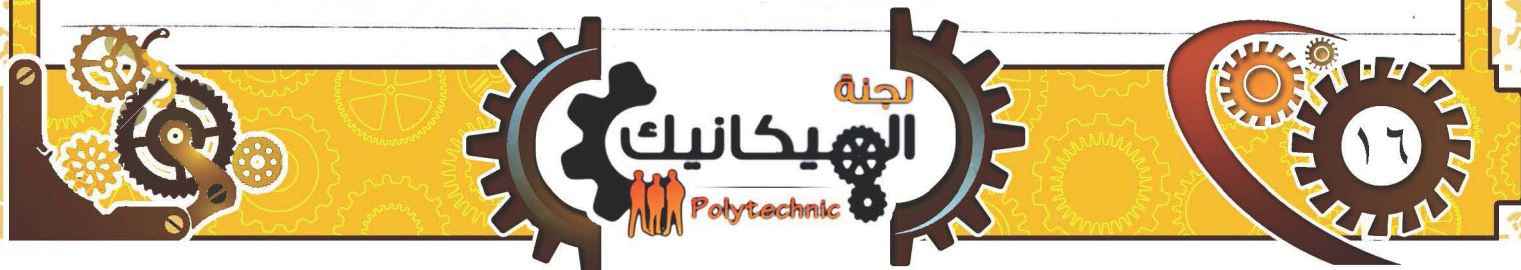
$$100 = E_a + (6)(0.1) \quad E_a = 99.4 \text{ [V]}$$

from table $I_f = 0.99 \text{ [A]}$

$$V_L = I_f (R_f + R_{fc})$$

$$100 = 0.99 (80 + R_{fc})$$

$$R_{fc} = 21 \text{ [}\Omega\text{]}$$



Al-Balqa Applied University
Faculty of Engineering Technology
Electrical Department

1. Machines

08.01.2005

2d exam

- Q1: Induction motor with $T_{max} = 2,6 T_{st}$, $X_1 = X_2' = 1,5 \Omega$. Find S_{cr} , R_2' then find the additional referred resistance to be connected to rotor winding, so the starting torque equal max.
- Q2: 3-phase, delta connected induction motor draws 43,3A line current Developing 229,3 N.M torque. If the motor became star connected With the same power supply what would be the line current and torque.
- Q3: 3-phase star connected induction motor, rotor speed 1440 R.P.M $R_2 = 1,5 \Omega$, 380V, $I_2 = 16A$. Find T_{em} , T_{shaft} neglecting rotational losses.
- Q4: 4-pole star connected, 5MVA synchronous generator $V_L = 6,6kV$, $PF = 0,8$ lag. If $X_{syn} = 2\Omega$ find E_o , voltage regulation and loading angle. Draw the phasor diagram
- Q5: 2-pole star connected, 660V synchronous generator delivering 500A With $PF = 0,8$ lag and 97% efficiency. Find the torque of the prime Mover needed in this case.



Q1) A single phase 2500/250 V, transformer has a maximum efficiency 0.96 when it delivers 0.9 full load at 0.85 power factor lagging, and has a magnetic losses 500 watt Determine:-

- The power at maximum efficiency (η_{max}) and the rated power (4-marks)
- the electrical losses and rated currents. (3-marks)
- The efficiency of the transformer at full load at 0.85 power factor. (3-marks)

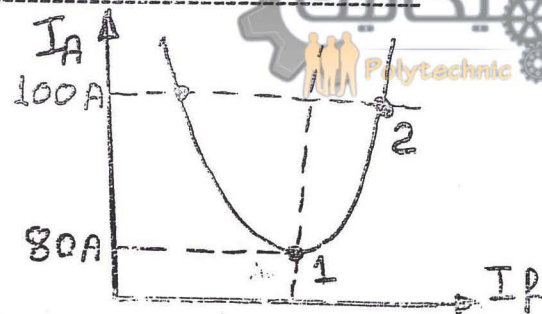
Q2) A 25 kw, 250V, 1600RPM, shunt DC motor has the following parameters;- $R_A = 0.25 \Omega$, $R_{sh} + R_{adj} = 150 \Omega$. The rotational losses are 750 watt.

- At 80% of full load find the speed, the electromagnetic torque, and the efficiency. (4-marks)
- Find the value of the terminal voltage needed to supplied the motor to limit the starting current to 2.5 times the full-load current $2.5 I_{FL}$ (2- marks)
- If the $R_{sh} + R_{adj} = 100 \Omega$ Find the speed of the motor at full load (2-marks)

Q3) A 3-phase, 480V, 6-Poles, 960 RPM, Y-connected, wound-rotor induction motor which produces loading torque 110 N.m on the shaft of the motor, and the efficiency of the motor is 0.9. The motor has a resistances ($R_1 = 0.5 \Omega$, $R'_2 = 0.4 \Omega$ and the stray losses are 200 watt. Find:-

- The out put power, mechanical power and electromagnetic power. (3-marks)
- The in put power and the stator current if the $\cos \phi = 0.85$. (2-marks)
- The stator and the rotor electrical losses and the magnetic losses. (3-marks)
- The value of the resistance which inserted with series in the rotor circuit which makes the starting torque equal maximum torque (2-marks)
- The value of the voltage supplied the motor which makes the speed of the motor equal the speed at maximum torque ($S_c = S_{FL}$) (3-marks)

Q4) A V-curve of a 3-phase, 480V, 4-pole, Y-connected synchronous generator is shown in figure (1). The generator has a synchronous reactance $X_s = 2 \Omega$ (ignore R_A) What is the generated voltage and electromagnetic power and torque at points (1 and 2)? (10-marks)



- Q5) a.) Briefly explain the static stability operation of the induction motor under load. (6-marks)
- b) State the speed control methods of the induction motors. (3-marks)

Good luck

Dr. Omar Barbarawi



* Final exam Q2)-

shunt DC motor

$$P_{in} = V_T I_T$$

$$2500 = 250 I_L \Rightarrow I_{FL} = 100 A, I_{0.8FL} = 80 A$$

$$I_{sh} = \frac{V_T}{R_{sh} + R_{adj}} = \frac{250}{150} = 1.67 A$$

$$I_L = I_A + I_{sh}$$

$$100 = I_{AFL} + 1.67 \Rightarrow I_{AFL} = 98.3 A$$

and

$$80 = I_{A0.8FL} + 1.67 \Rightarrow I_{A0.8FL} = 78.3 A$$

$$V_T = E_A + I_A R_A$$

at FL: $250 = E_A + 98.3(0.25) \Rightarrow E_{AFL} = 225.4 V$

at 0.8FL: $250 = E_A + 78.3(0.25) \Rightarrow E_{A0.8FL} = 230.4 V$

$$\frac{E_{AFL}}{E_{A0.8FL}} = \frac{n_{FL}}{n_{0.8FL}} \Rightarrow \frac{225.4}{230.4} = \frac{1600}{n_{0.8FL}} \Rightarrow n_{0.8FL} = 1635.5 \text{ RPM}$$

$$P_{em} = E_{A0.8FL} * I_{A0.8FL} = 230.4 * 78.3 = 18040 W$$

$$T_{em} = \frac{P_{em}}{\omega_m} = \frac{18040}{\frac{2\pi(1635.5)}{60}} = 105.3 \text{ N.m}$$

$$P_{out} = P_{em} - P_{rot} = 18040 - 750 = 17290 W$$

$$\eta = \frac{P_{out}}{P_{in}} = \frac{17290}{25000} = 69\%$$



$$\textcircled{b} \quad I_{st} = \frac{V_T}{R_A} \Rightarrow 2.5 I_{FL} = \frac{V_T}{R_A} \Rightarrow 2.5 (100) = \frac{V_T}{0.25}$$

$$\Rightarrow \boxed{V_T = 62.5 \text{ V}}$$

$$\textcircled{c} \quad I_{FL} = 100 \text{ A} , \quad I_{0.8 FL} = 80 \text{ A}$$

$$I_{sh} = \frac{250}{100} = 2.5 \text{ A}$$

$$I_L = I_A + I_{sh}$$

$$100 = I_{AFL} + 2.5 \Rightarrow I_{AFL} = 97.5 \text{ A}$$

$$80 = I_{0.8FL} + 2.5 \Rightarrow I_{0.8FL} = 77.5 \text{ A}$$

$$V_T = E_A + I_A R_A$$

$$\text{at FL: } 250 = E_A + 97.5(0.25) \Rightarrow E_{AFL} = 225.6 \text{ V}$$

$$\text{at 0.8 FL: } 250 = E_A + 77.5(0.25) \Rightarrow E_{A0.8FL} = 230.6 \text{ V}$$

$$\frac{E_{AFL}}{E_{A0.8FL}} = \frac{n_{FL}}{n_{0.8FL}} \Rightarrow \frac{225.6}{230.6} = \frac{1600}{n_{0.8FL}}$$

$$n_{0.8FL} = \boxed{1635.5 \text{ RPM}}$$





Albalq'a Applied University

Faculty of Engineering Technology

Electrical Machines

Final Exam

Date 4/6/2007

- Q1) A30 KVA, 3000 /300 V, single phase transformer has the following parameters:-
 $R_{eq1}=5\Omega$, $X_{eq1}=6\Omega$, $R_m = 4K\Omega$, $X_m = 400\Omega$ and the active no load current $I_{nl,a}=0.25A$. Find at 0.8 full load and unit power factor the efficiency and the voltage regulation of the transformer. (7marks)
- Q2) A 30 KW, 300V,1800 RPM ,long-shunt compound DC generator has the following parameters $R_A=0.25\Omega$, $R_{se}=0.05\Omega$, $R_{sh} + R_{adj}=100\Omega$ and the rotational losses is 900 Watt .
 IF the generator operates at speed of 1500RPM and at 0.7 of full load Find the V_T , the applied torque , electromagnetic torque and the efficiency. (12mar)
- Q3) A 3 phase , 660V, 6-pole, 50Hz, 975 RPM,Y-connected , squirrel-cage induction motor has the following parameters per phase :-
 $R_1=0.2\Omega$, $R_2=0.25\Omega$, $X_1=X_2=0.6\Omega$, $R_m=10\Omega$, $X_m=20\Omega$, P_F , w, s. losses=1KW
 Find at full load :-
 1. The stator, rotor and the no load currents
 2. Pin , Pem , Pout and the maximum torque
 3. The generated voltage in the rotor at locked rotor and at run case if the flux per pole is 0.0563 wb. (13 mark)
- Q4) A 3 phase , 2-pole ,198KVA ,660V , Δ -connected synchronous generator has $X_s=2\Omega$, negligible R_A , and $P_{rot}=5Kw$.
 If the generator operates at 0.8 PF Leading Find:-
 1. The generated voltage $E_A \angle \delta$, The active power and the applied Torque.
 2. IF the excitation current is increased by 20% with prime mover torque constant ,Find the new $E_A \angle \delta$, I_A , and $\cos \phi$. (10marks)
- Q5) a) State the starting method and control speed of the induction motor
 b) Draw the mechanical (Torque-speed) characteristic of induction machine (8mar)

Good luck

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