Agricultural and Biosystems Engineering Dept. 11/1/07
Iowa State University CJB

Name KEY

AE 363 - Exam 2

1 - 8 ½ x 11 sheet open (both sides)
Multiple Choice: 1 pt. each

1) A + 1
   a) A
   b) 1
   c) 0
   d) none of the above

2) This is an advantage of ball-type bearings in motors, as compared with sleeve bearings.
   a) quietness
   b) initial cost
   c) ability to accept radial thrust
   d) low friction

3) A motor with a full-load speed of 1150 RPM has this many poles:
   a) 2
   b) 4
   c) 6
   d) 8

4) For an induction motor to run at a speed over 3600 rev/min,
   a) the power frequency must exceed 60 Hz
   b) the motor must have less than 2 poles
   c) DC power must be used
   d) is impossible

5) The no-load efficiency of a single phase motor is
   a) zero percent
   b) usually 5-20%
   c) usually 25-50%
   d) usually over 60%

ave 80

90 & 8
80 & 17
70 & 4
60 & 5
50 & 1

6) If a capacitor is installed in parallel with a split phase motor,
   a) the starting torque of the motor will be improved
   b) the efficiency of the motor will be improved
   c) the phase angle between the current and voltage for this combination will be different than for the motor alone.
   d) a & b
   e) a & c
   f) b & c
   g) a, b, & c

7) The slip of an inductor motor running at 3450 rev/min is
   a) 50 rev/min
   b) 150 rev/min
   c) 3600 rev/min
   d) 1650 rev/min

8) The load on a 1/2 HP induction motor is increases to 1 HP. When this is done, the motor will
   a) stop.
   b) slow to about 1/2 of full load speed.
   c) maintain full load speed.
   d) slow to about 95% of full load speed.
   e) light up like a Christmas tree

EITHER

9) Current to a dual-voltage motor is measured to be 7.5 amps. The nameplate states 10 amps/5 amps. The motor is being operated at 230 V.
   a) this motor is overloaded.
   b) this motor is loaded to less than its rated output hp.
   c) one cannot determine from the information given whether the motor is overloaded or underloaded.
   d) the motor is not being loaded.

10) Which is NOT a required component of a motor circuit?
   a) short circuit protection
   b) disconnect device
   c) control device
   d) lightening protection device

11) When calculating conductor size needed to supply a single motor, use this amperage:
   a) locked rotor current.
   b) 125% of locked rotor current.
   c) full load current.
   d) 125% of full load current.

12) This is the most expensive enclosure type:
   a) TENU
   b) TEFC
   c) Explosion proof
   d) ODP
   e) TOHA

13) The normal slip of an induction motor under no load is
   a) 0 - 1%
   b) 3 - 5%
   c) 7 - 10%
   d) 10 - 25%

14) A wild phase is present on this type of service:
   a) wye
   b) delta
   c) both wye and delta
   d) neither wye nor delta

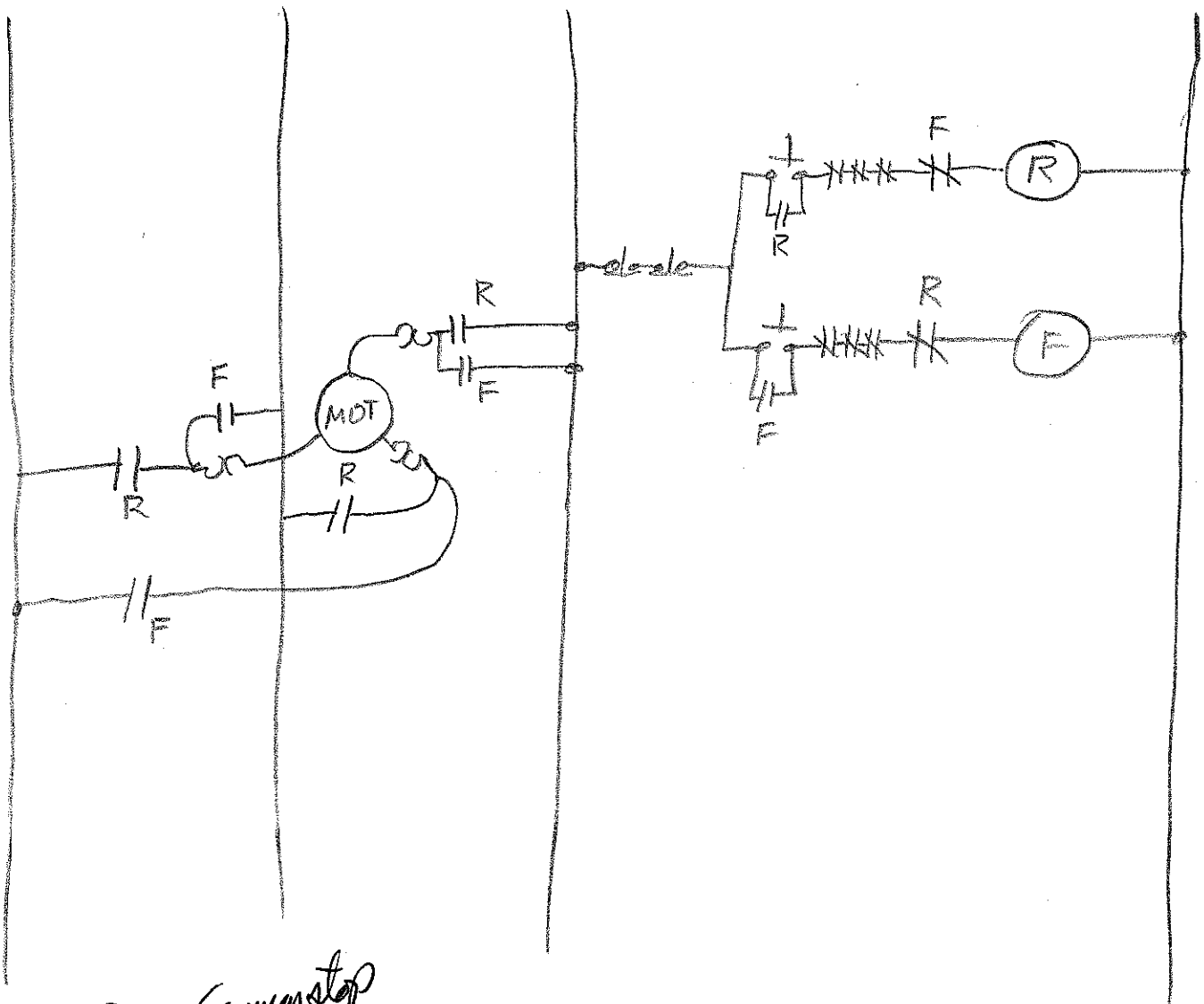
15) This is NOT an advantage of 3-phase power:
   a) smaller generator size for same capacity
   b) simpler motors
   c) lighter conductors for same power delivery
   d) reduced shock hazard
   e) exactly constant power flow to a load

16) How many phase sequences are possible on a 3-phase power system?
   a) 1
   b) 2
   c) 3
   d) 4
   e) 5

17) A solid-state relay
   a) has no moving parts
   b) has load "contacts" that never really close
   c) has load "contacts" that never really open
   d) a,b,c

18) When a PLC input is on, an NC contact with this input's address is
   a) closed
   b) open
   c) can be either

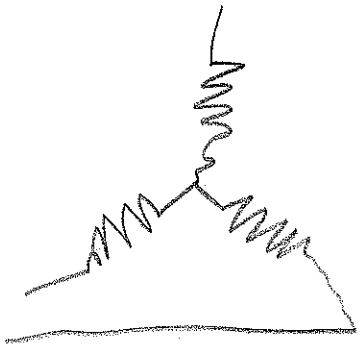
(20) 19. A three-phase motor is to be controlled by two magnetic motor starters having 120-volt coils and control circuits wired so that when start button F is pressed, the motor starts and runs in the forward direction, and when start button R is pressed, the motor starts and runs in the reverse direction. If the motor is running, the control circuit prevents running the motor in the opposite direction. Either of the two stop buttons will stop the motor, regardless of what direction it's running. Each magnetic motor starter is equipped with three NO load poles, an NO auxiliary contact pole, and an NC contact. Draw the ladder diagram of the load and control circuits.

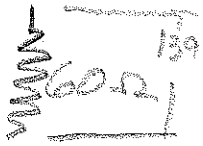


-3 Common stop

(20) 21. Three 60-ohm resistors are to be connected to a 240-V 3-phase service.

a) Sketch a wye connection of the resistors and calculate line current, phase current, and total power.





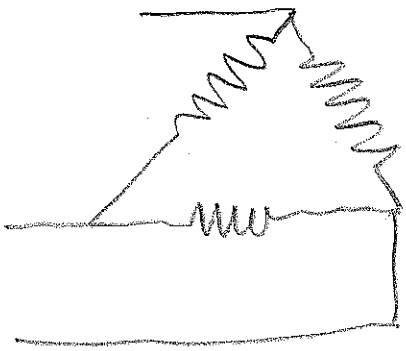
$\frac{240}{\sqrt{3}} = 139$

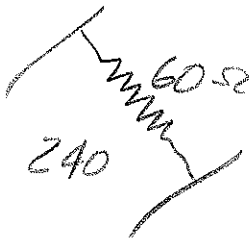
$I_P = \frac{139}{60} = 2.31A$

$I_L = 2.31A$

$P = \sqrt{3}(2.31)(240)(1) = 960W$

b) Sketch a delta connection of the resistors and calculate line current, phase current, and total power.





$I_P = \frac{240}{60} = 4$

$I_L = 4(\sqrt{3}) = 6.93$

$P = \sqrt{3}(6.93)(240)(1) = 2880W$

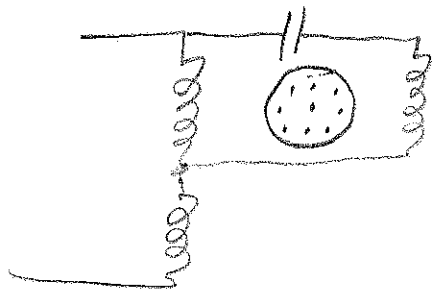
(21) 21. A permanent split capacitor motor has this nameplate information:

230 volt single phase 1 hp 10 amps 1725 rpm

Its characteristics graph is on the next page.

The motor is loaded and is running at 1675 rpm, 230 volts, 14 amps, 2100 watts

4 a) Sketch the circuit of this motor



4 b) Assuming hp is proportional to slip, what is the output of the motor as it runs at 1675 rpm?

1800 − 1675 = 125

1800 − 1725 = 75

$\frac{.75}{1} = \frac{125}{x}$

$X = 1.67$ hp

4 c) What is the efficiency of the motor as it runs at 1675 rpm?

$E = \frac{(1.67)(746)}{2100} = 59.2\%$

4 d) What torque is the motor capable of producing as it starts a load?

$HP = \frac{2\pi nwN}{33000}$ $\quad nw = \frac{(1)(33000)}{2\pi(1725)} = 3.04$ LB.FT

$(.5)(3.04) = 1.52$ LBFT

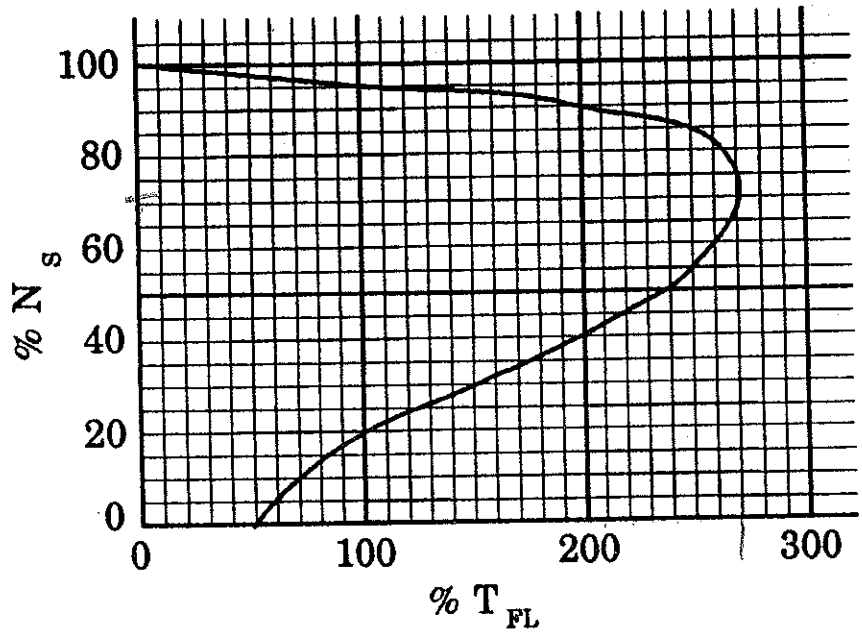
5 e) What is the hp output of this motor when operated at its breakdown torque?

$(3.04)(2.7) = 8.22$

$(.7)(1800) = 1260$

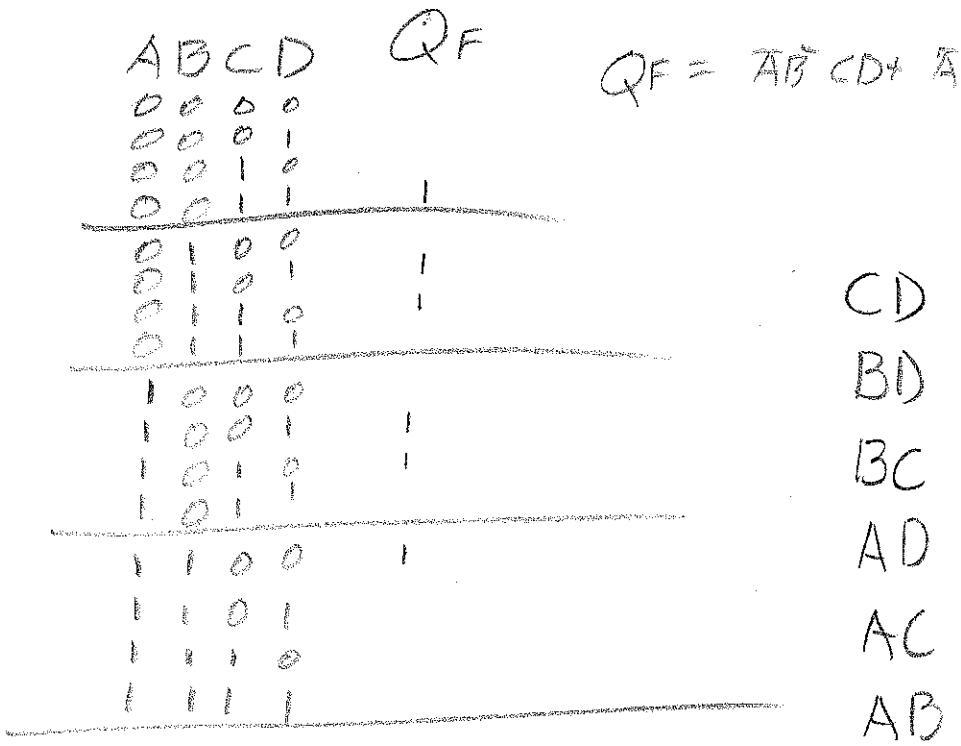
$HP = \frac{2\pi(8.22)(1260)}{33000}$

$= 1.97$ hp



b. Typical torque-speed characteristics

(21) 22. A ventilation system is controlled by four thermostats placed at various locations around a building. All the thermostats are set to close when the temperature exceeds 80 F. The ventilation fan is to turn on whenever at least two of these thermostats close. Assume these thermostats are inputs to a digital logic control system. Write the QF equation which defines when the fan is to run. Hint: Don't worry about 3 or 4 closed thermostats because in these situations, the fan has started as soon as there were 2 ~~fans running.~~ THERMOSTATS CLOSED.



$QF = A\bar{B}CD + A\bar{B}C\bar{D} + ABCD + A\bar{B}\bar{C}D + ABC\bar{D} + AB\bar{C}\bar{D}$