Tanta University

Electrical Power and Machines Engineering Department

Faculty of Engineering

Course Title: **Electrical Machines (3)**	Course Code: **EPM3215**	Year: **3rd**
Date: **Jun. 11th 2023**	Allowed time: **3 hrs**	No. of Pages: **(2)**
	Total Marks: **120 Marks**	

Remarks: (answer the following questions… assume any missing data… answers should be supported by sketches if possible)

Question Number (1) (30 Marks)

A three-phase, **230-V, 60-Hz, 1125 rpm, 6-pole, delta**-connected squirrel-cage induction motor has the following equivalent circuit parameters: $R_1 = 0.21\ \Omega$, $X_1 = X_2 = 0.72\ \Omega$, $R_c = 120\ \Omega$, $X_m = 40\ \Omega$. The motor develops the maximum torque at a speed of **1000 rpm**. The friction loss is **5%** of the developed power. The stator to rotor turns ratio is **1 : 0.5. Answer the following:**

(i) **Determine** the referred rotor resistance.

(ii) **Determine** the **rated** line current and power factor.

(iii) **Determine** the **rated** air-gap power, developed power and shaft horsepower.

(iv) **Determine** the **rated** developed torque and shaft torque.

(v) **Determine** the motor efficiency at rated conditions.

(vi) **Determine** the **magnitude** and the **frequency** of the voltage induced in the rotor.

(vii) **Determine** the **speed** of the **rotor field** with respect to the rotor structure, the stator structure, and the stator field.

(viii) Aiding with the **torque-speed** curve, **name** the different modes of operation of a three-phase induction machine. **suggest** an appropriate method for **fast stopping**, *then*, **name** the operating mode **and draw** the corresponding **power flow diagram.**

Question Number (2) (30 Marks)

A three-phase, **9 hp, 440 V, 50 Hz, 4-poles,** Y-connected wound-rotor induction motor. The friction and windage loss is **35 W** and the stator resistance between any two line terminals is **1.5 Ω**. It gave the following readings when tested at the rated conditions.

No-load test: 6 A, 0.12 lagging pf	**Blocked-rotor test: 92 V, 12 A, 660 W**

(i) **Find** the parameters of the equivalent circuit and the full-load efficiency.

(ii) **Determine** the starting torque, the breakdown torque and the corresponding power.

(iii) **If** the rotor resistance of this machine is doubled, **calculate** the new value of starting torque and breakdown torque. **Sketch** the *torque-speed* curve both with the original rotor resistance and with the doubled value.

(iv) **If** the induction machine is operated at 4% slip (negative), **determine** the mode of operation, the **motor speed,** and its **direction** relative to the rotating field.

(v) **Repeat part (iv),** if the induction machine operates at 150% slip (positive).

(vi) **If** the **shaft load** of an induction motor is **increased**, how do the following quantities **change**?

(1) rotor speed	(2) slip	(3) slip speed	(4) synchronous speed
(5) rotor induced voltage	(6) rotor current	(7) rotor frequency	(8) rotor copper loss

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P.T.O

Question number (3) **(30 Marks)**

a) A **175-hp**, three-phase, **50-Hz, 220-V, six-pole, delta-connected** wound-rotor induction motor controls a speed of **a constant-torque load** and develops its rated full-load output at a speed of **930-rpm** when operated at rated voltage and frequency with its slip rings short-circuited. The **maximum torque** it can develop at rated voltage and frequency is **3.25 times** the full-load torque. The resistance of the rotor winding is **0.15 Ω /phase**. Neglect any effects of rotational and stray-load loss and stator resistance.

(i) **Determine** the rotor copper loss at full load.

(ii) **Determine** the speed at maximum torque in rpm.

(iii) **How much** resistance must be inserted in series with the rotor windings to **produce** maximum starting torque?

(iv) **It is required to run the load at 800-rpm, how much** stator voltage should be reduced to get the required speed. The slip-torque relationship of the motor can be assumed to be linear from no load to full load conditions.

(v) **Determine** the starting torque and the rotor current at starting in per unit of full-load rotor current.

(vi) **Determine** the rotor current at maximum torque in per unit of full-load rotor current.

(vii) **If** the motor takes **1.65 times** full-load current when started by a star/delta starter, **determine** the autotransformer tapping for starting the motor so that the starting current should not exceed twice the full-load current. **calculate** the corresponding starting torque in terms of full-load torque corresponding. **(25 Marks)**

b) **Give short notes** on the following: **(5 Marks)**

(i) **time harmonics** and **space harmonics**	(ii) **crawling** and **cogging**	(iii) **starting code letters**

Question number (4) **(30 Marks)**

a) **Explain in details** the different methods used to control the speed of induction motors. **Illustrate why** it is necessary to reduce the **voltage** applied to an induction motor as the electrical **frequency** is reduced. **Illustrate** your answer with suitable sketches. **(15 Marks)**

b) **Name and describe** the different methods used to control the starting current of a 3-phase induction motor. For each one, **illustrate** the effect on; **line staring-current**, **motor staring-current** and **staring torque** with respect to the corresponding normal values. **(10 Marks)**

c) The equivalent impedances of a **double-cage**, 3-phase, 6-pole, Y-connected, induction motor are **0.6+j4.5 Ω/phase** and **3.4+j1.2 Ω /phase**. **(5 Marks)**

(i) **Illustrate** the importance of this motor type. **Name and assign** the impedance of each rotor cage?

(ii) **Determine** the ratio of torques developed by the two cages at standstill and at **5 % slip**. **Comment** on the results.

End of questions.....

WISH YOU ALL THE BEST *Prof. Said M. Allam*

Tanta University

Computers & Automatic Control Engineering Department

Faculty of Engineering

Course Title	Microprocessors	Academic Year 2022/2023 Second Semester Exam	Course Code	CCE3271
Year/ Level	3rd , Power and Electrical Machines Dept.		Total Marks	70
Date	7-6-2023	No. of Pages (3)	Allowed time	3 hrs

Answer all the following questions. Assume any missing data.

Question Number (1): (20 points)

a) Determine each of these statements is true or false. **(15 points)**

1. The RAM is a read-write memory which can rapidly read and write the data.
2. The "COMF" instruction affects the "Z", "C", and "DC" flags.
3. The "W" register is not a part of the register-file but is a stand-alone register.
4. Comments are for documenting the source program so that it will be easy to read and understand.
5. PIC 16F877A has different sizes of data memory and program memory.
6. PIC 16F877A has 8K word (14 bits) flash memory.
7. The writing of an EEPROM is not the same as a RAM since the data-writing time of the EEPROM is about ten thousand times as long as the data-writing time of the RAM.
8. All the instructions in PIC16F877A are each 16 bits long.
9. TOCS is Timer0 Clock Source Select bit. It has "1" if a signal is presented on T0CKI pin (RD5 pin).
10. The "NOP" instruction means "No Operation". It does not take time for the PIC to run it.
11. In PIC16F877, CALL and GOTO are always executed in one instruction cycle.
12. Microcontrollers are normally less expensive than general purpose microprocessors.
13. The instruction MOVWF PORTA use the indirect addressing mode.
14. When we add two numbers, the destination address must always be the work register.
15. The program EEPROM (Flash Memory), in PIC16F877, works with 14-bit-wide words and contains the user's instructions.

b) Write an assembly program that stores 0x00 (clear) in 30 memory locations starting from the memory address 11H. (5 points)

Question Number (2): (20 points)

a) If (1:256) prescaler is assigned to TMR0 with frequency 4MHz. Find: (6 points)
   1. The overflow time of TMR0.
   2. No. of required overflows to get 5 seconds.
   3. No. of required overflows to get 10 seconds. If the initial value of TMR0 = 0.

b) Write a program to use TMR0 as a counter such that the counter input is connected to a push button so that any button press causes timer TMR0 to count one pulse. When the number of pulses equals to 10, send a logic one on the RD3 pin. (7 points)

c) Write a program to add two 8-bit numbers in memory location LOC1 and LOC2. Save the sum in memory locations SUM. Which flags will be affected? (7 points)

Question Number (3): (20 points)

a) Choose the correct answer from the following choices: **(15 points)**

1. Which flags are more likely to get affected in status registers by Arithmetic and Logical Unit (ALU) of PIC16F877 based on instructions execution?
   a. Carry (C) Flag **b.** Digit Carry (DC) Flag
   c. Zero (Z) Flag **d.** All of the above

2. Which timer/s possess an ability to prevent an endless loop hanging condition of PIC along with its own on-chip RC oscillator by contributing to its reliable operation?
   a. Power-Up Timer (PWRT) **b.** Watchdog Timer (WDT)
   c. Oscillator Start-Up Timer (OST) **d.** All of the above

3. … requests the microcontroller to stop the normal execution of program and execute a special code.
   a. Interrupt **b.** CALL instruction
   c. Subroutine **d.** All of the above

4. Which register/s is/are mandatory to get loaded at the beginning before loading or transferring the contents to corresponding destination registers?
   a. Work Register **b.** PCL Register
   c. INDF Register **d.** All of the above

5. Which status bits exhibit carry from lower 4 bits during 8-bit addition and are especially beneficial for BCD addition?
   a. Carry bit (C) **b.** Both a & b
   c. Digits Carry bit (DC) **d.** None of the above

6. Which bit of OPTION register has a potential to decide the falling or rising edge sensitivity for the external clock source?
   a. RBPU **b.** PSA
   c. INTEDG **d.** TOSE

7. The "GOTO" instruction always executes in … instruction cycles.
   a. One **b.** Two
   c. Three **d.** Four

8. Which program location is allocated to the program counter by the reset function in Power-on-Reset (POR) action modes?
   a. Initial address **b.** Final address
   c. Middle address **d.** At any address

9. Which register acts as an input-output control as well as data direction register for PORTA in bank 2 of RAM?
   a. INDF **b.** TRISA
   c. STUTS **d.** PCLATH

10. The location "TEMP" contained 0xAB, after doing a "SWAPF TEMP,W", "TEMP" will contain
    a. 0xAB **b.** 0xBA
    c. 0x00 **d.** oxFF

11. Which among the CPU registers of PIC16F877 is not 8-bit wide?
    a. Status Register
    b. File Selection Register (FSR)
    c. Program Counter Latch (PCLATH) Register
    d. None of the above
12. Both the "INCF" and the "DECF" have the same operation format, and both affect the … flag.
    a. Carry
    b. Zero
    c. Overflow
    d. No
13. Which bit of OPTION register has a potential to decide the falling or rising edge sensitivity for the external clock source?
    a. RBPU
    b. INTEDG
    c. PSA
    d. TOSE
14. What is the purpose of setting TOIE bit in INTCON along with GIE bit?
    a. For setting the TOIF flag in INTCON due to generation of Timer 0 overflow interrupt.
    b. For setting the TOIE flag in INTCON due to generation of Timer 0 overflow interrupt.
    c. For setting the RBIF flag in INTCON due to generation of PORTB change interrupt.
    d. None of the above.
15. Which statement is precise in relation to FSR, INDF and indirect addressing mode?
    a. Address byte must be written in FSR before executing INDF instruction in indirect addressing mode.
    b. Address byte must be written in FSR after executing INDF instruction in indirect addressing mode.
    c. Address byte must be written in FSR at the same time during the execution of INDF instruction in indirect addressing mode.
    d. Address byte must be always written in FSR as it is independent of any instruction in indirect addressing mode.

b) Write a program to monitor bit PortC.0. When it is high, send 55H to PortB. Otherwise, send AAH to PortB. (5 points)

Question Number (4): **(10 points)**

a) State 4 differences between microprocessors and microcontrollers. (4 Points)
b) Write a program to toggle (flash) bit RB0 every 10 sec, use a suitable endless loop. (6 points)

End of questions.....

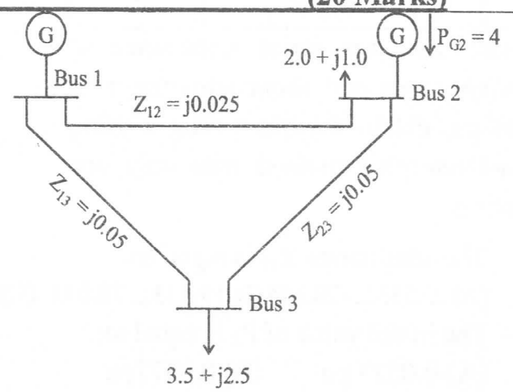
Good Luck

Dr. Basma Elkilany

5. The zero-sequence impedance of an element in a power system is generally different from
(a) positive sequence; (b) negative sequence; (c) both (a) and (b) ; (d) none of these
6. The positive sequence component of voltage at the point of fault is zero when it is a
(a) three phase fault; (b) L-L-G fault; (c) L-G fault; (d) L-L fault
7. Which one of the following is a correct statement?
(a) 1 + a + a2 = 0, (b) 1 – a + a2 = 0, (c) 1 – a + a2 = 0, (d) 1 – a – a2 = 0.
8. Which of the following reactance is eliminated first in synchronous generator just after the symmetrical fault?
(a) Damper winding reactance, (b) Armature winding reactance, (c) Field winding reactance.

Problem number (4) **(20 Marks)**

The following figure shows the one-line diagram of a simple three bus power system with generation at buses 1 and 2. The voltage at bus 1 is $1.0\angle 0°$ p.u. and voltage magnitude at bus 2 is **fixed** at 1.04 p.u. If all data given are in per unit, complete the sentences from 1 to 10 using **Gauss-Seidel** method with two iterations considering the following initial values: $V_2 = 1.04\angle 0°$ p.u. and $V_3 = 1.0\angle 0°$ p.u.



1- The admittance Y_{22} is equal to:
(A) –j60 (B) –j20 (C) –j40 (D) j60 (E) j40
2- The initial value of generated reactive power at bus 2:
(A) 2.496 pu(B) 1.496 pu (C) 3.496 pu(D) 2.46 pu (E) -1.0 pu
3- The value of generated reactive power at bus 2 after one iteration:
(A) 2.46 pu (B) 1.496 pu (C) 3.46 pu (D) 2.496 pu(E) -1.0 pu
4- The angle of voltage at bus 2 after one iterations is:
(A) –4.89° (B) -4.27° (C) 1.77° (D) 0.55° (E) 0°
5- The magnitude of voltage at bus 3 after one iterations is:
(A) 0.952 pu(B) 1.4781 pu (C) 1.0 pu (D) 1.606 pu(E) 0.95991 pu
6- The angle of voltage at bus 3 after one iterations is:
(A) 4.2677° (B) 0.55° (C) -4.27° (D) -2.15005° (E) 0°
7- The magnitude of voltage at bus 2 after two iterations is:
(A) 0.95991pu (B) 0.960 pu (C) 1.0 pu (D) 1.04 pu (E) 0.944 pu
8- The angle of voltage at bus 2 after two iterations is:
(A) –4.89° (B) -4.27° (C) 0.55° (D) 1.77° (E) 0°
9- The magnitude of voltage at bus 3 after two iterations is:
(A) 0.944 pu(B) 0.960 pu (C) 1.0 pu (D) 1.04 pu (E) 0.952 pu
10- The angle of voltage at bus 3 after two iterations is:
(A) –4.27 ° (B) -4.89° (C) 0.55° (D) 1.77° (E) 0°

Electrical Power and Machines Engineering Department
Tanta University - Faculty of Engineering

Total Marks: 125 Marks

Course Title: Power System Analysis	Course Code: EPM3214	Year: 3rd
Date: 4/ 6/ 2023 (Second term)	Allowed time: 3 h	number of pages 4

Problem number (1) **(20 Marks)**

Three-phase generator supplies synchronous motors and static load over a transmission line having transformers T_1 and T_2 at both ends, as shown in the one-line diagram of Fig. 1. The system data is:

G	30 MVA	13.8 kV	x_d=0.3	x_d''=0.1	x_d'=0.2
T_1	30 MVA	13.8/120 kV	x=0.1		
T_2	30 MVA	12/120 kV	x=0.1		
TL	30 MVA	120 kV	x=0.15		
SM	20 MVA	12 kV	x_d=0.3	x_d''= 0.2	x_d'=0.2

The static load has rated of 20 MVA and 12 kV at 0.8 lagging power factor. Neglect pre-fault conditions.

a) Find the sub-transient current in the transmission line for a symmetrical three-phase fault at the point P.
b) Find the momentary currents in breakers A and B.

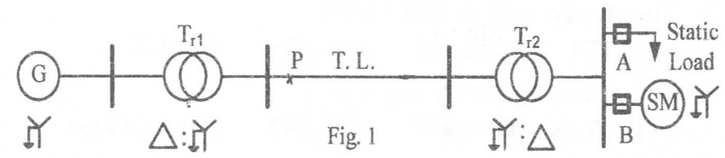


Fig. 1

Problem number (2) **(20 Marks)**

Two 11 kV, 20 MVA, three-phase, star connected generators operate in parallel. The positive, negative and zero sequence reactances of each are j0.18, j0.15 and j0.1 pu, respectively. The star point of one of the generators is isolated and that of the other is earthed through a j0.33 pu reactance. A LLG fault occurs at the generators terminals. Estimate,
a) The fault current; b) The phase and line terminal voltage during the fault; c) The fault current contribution of each generator; d) The current in grounding reactance; e) The voltage across grounding reactance.

Problem number (3) **(24 Marks)**

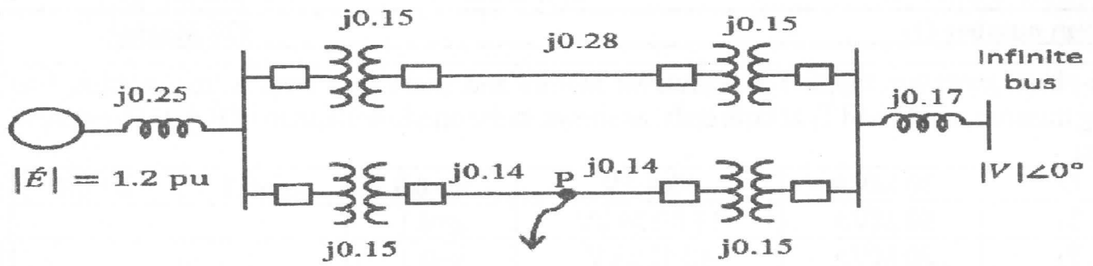
A. Derive an expression for calculating the symmetrical fault using the bus impedance matrix. **(8 Marks)**

B. Choose the correct answer for the following sentences. **(16 Marks)**

1. the most common type of three-phase in unsymmetrical fault is
(a) single line to ground; (b) line to line; (c) line to line to ground; (d) symmetrical three-phase
2. In a balance three-phase system, negative and zero sequence currents are
(a) equal; (b) zero; (c) different; (d) none of these
3. The +ve and -ve sequence impedances of a transmission line are
(a) equal; (b) zero; (c) different; (d) none of these
4. The zero-sequence impedance of different elements of power system is generally
(a) equal; (b) zero; (c) different; (d) none of these

Problem number (6) **(21 Marks)**

For the system shown in the given Figure for a three-phase fault at the point P. The generator is delivering pu power under prefault conditions. Answer the multiple choice question then Find the critical clearing angle.



Considering prefault operation

1- The transfer reactance between generator and infinite bus is
(A)0.71 (B) 0.29 (C) 0.46 (D) 0.54

2- The steady state stability limit
(A)4.138 (B) 2.609 (C)1.69 (D) 2.222

3- The operating power angle is
(A) 0.633 (B) 0.467 (C)0.393 (D) 0.244 pu

During fault

4- The transfer reactance is
(A)2.424 (B) 7.23 (C) 6.24 (D) 1.54

5- The stability limit
(A) 0.495 (B) 0.166 (C)0.192 (D) 0.779

Postfault operation ***(faulty line switched off)***

6- The transfer reactance is
(A)1 (B) 0.75 (C) 0.83 (D) 0.85

7- The stability limit
(A) 1.2 (B) 1.6 (C)1.45 (D) 0.71.412

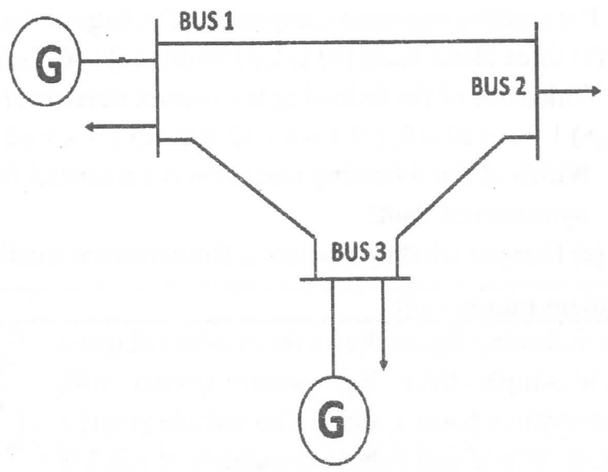
Good Luck

Course Examination Committee:

Assoc. Prof. Hossam A. Saleh & Dr. Eman Gaber

Problem number (5) **(20 Marks)**

The following figure shows the one-line diagram of a simple three bus power system has the following data.



Bus	P_d	Q_d	P_g	Q_g	V
1	1	0.5	-	-	1.03+J0
2	1.5	0.75	0	0	-
3	1	0.2	0.5	-	1

If each line has series impedance of (0.02+j0.1) pu and shunt admittance of j0.04 pu, obtain the bus voltages using **Fast-Decoupled** method with only one iteration.

1- The admittance Y_{11} is equal to:
(A)19.533∟-78.644 (B)19.533∟78.644 (C)19.612∟78.723 (D)19.612∟-78.723

2- The initial value of P_2 is equal to:
(A)-0.0577 pu (B) 0.0577pu (C) -1.5 pu (D) 1.5 pu

3- The initial value of Q_2 is equal to:
(A) -0.369pu (B) 0.369 pu (C) 0.75 pu (D) -0.75 pu

4- The initial value of ΔP_3 is equal to:
(A)-0.0577 pu (B) -0.442 pu (C) 1pu (D) 0.0577pu

5- The magnitude of voltage at bus 3 after one iteration is:
(A) 0.9575 pu (B) 1pu (C) 0.98007 pu (D) 1.03 pu

6- The angle of voltage at bus 2 after one iterations is:
(A) 0.1162° (B) -0.1162° (C) -6.658° (D) 6.658°

7- The magnitude of voltage at bus 2 after one iteration is:
(A) 0.9575 pu (B) 1pu (C) 0.98007 pu (D) 1.03 pu

8- The angle of voltage at bus 3 after one iteration is:
(A) 0.08144° (B) -4.6662° (C) -0.08144° (D) 4.6662°

9- The generated reactive power at the voltage control bus after one iteration is:
(A) 4.454 pu(B) 3.454 pu (C) 0.454 pu(D) -1.454 pu (E) 2.454 pu

10- The generated power at the slack bus after one iteration is:……..