Menoufia University

Faculty of Electronic Eng.

Dep. of Ind. Electronics and Control Eng.



Final Term Exam - 3<sup>rd</sup> year (2019/2020)

Elective-1 (Mechatronics) - ACE316

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Time Allowed: 3 Hours

A 1018

## Answer the following 5 questions:

Question No. (1): [20 Marks]

#### > True or False and correct the false ones?

- 1. Low initial cost is one of the advantages of Mechatronics systems.
- 2. Trained workers with only one engineering field background is essential in Mechatronics systems.
- 3. Mechatronics systems does not include sensors and actuators elements.
- 4. In a measurement system, the transducer performs filtering, amplification, or other signal conditioning on the transducer output.
- 5. In mechatronic systems, signal processing facilitates the higher-level monitoring of the manufacturing operation.
- 6. Sensor's accuracy is the measuring instrument's property to respond to the measured quantity changes.
- 7. LVDT sensor has three primary and four secondary coils with same number of turns for primary ones.
- 8. A dummy gauge can be used with the strain gauge in Wheatstone bridge to remove the pressure effect.
- 9. Absolute encoder must have an external processing of signals to obtain the angular position of a motor.
- 10. The insurance that a mechanism will exhibit motion that will accomplish the set of requirements is called Mechanism's synthesis.
- 11. In mechanism's kinematics analysis, the required maximum force of a mechanism must be determined.
- 12. Cam and follower mechanism can transform a translational motion into a rotary motion.
- 13. Higher order joint allows rotary motion between the two links that it connects.
- 14. Crossed-belt drive is used when driven and driving pulleys are to be rotated in the same direction.
- 15. The frame is the mechanical portion of a machine that has the function of transferring motion and forces from a power source to an output.
- 16. fluid link is a link which is partially deformed in a manner that affects the transmission of motion.
- 17. Pin or hinge joint allows pure translation between the two links that it connects.
- 18. Point of interest is typically the part of the mechanism or the machine that exhibits no motion
- 19. If a link is in a pure translation, the orientation of the link will be variable
- 20. Revolute joints may allow both rotation and sliding between the two links that it connects.

# Ouestion No. (2): [15 Marks]

#### > Choose the correct answer:

- 1- A good example of manufacturing applications of mechatronics system is ......
  - a- Automobile b- high speed train c- Segway robot d- CNC machines e- all of the above
- 2- The sensor's ...... measures the difference between the measured value and actual value.
  - a-repeatability b- sensitivity c- precision d- accuracy

3-	A sensor can be found in Laptop track Pads.							
	a- capacitive	b- inductive	c- both	a and b	d- none of the above			
4-	LVDT can be cons	idered as	sensor.					
	a- capacitive	b- inductive	c- resi	stive	d- none of the above			
5-	The gauge factor of	f a strain gauge is						
	a- $\frac{\Delta R/_R}{\Delta L/_L}$	$b - \frac{\Delta L}{\Delta R}$	$\frac{L}{R}$	$c - \frac{\Delta R/_R}{\Delta D/_D}$	$d - \frac{\Delta R/R}{\Delta \rho/\rho}$			
6-	In the Encoder,	is used	d to filter signal	into square wave	e used by microcontroller.			
	a- Mask b-	LED	c- Photodete	ector	d- Electronic board			
7-	Theencoder	keeps the correct p	osition value in	case of loss of po	ower,			
	a- single channel in	cremental b- Dual	channel increme	ental c- ab	solute d- none of the above			
8-	The heart of any ma	achine that is used to	transfer motion	n from power so	urce to an output is called			
	a- kinematics	b- dynamics	c- t	ooth a and b	d- none of the above			
9involves determination of position, velocity, and acceleration of a mechanism								
	a- Kinematics	b- Dynamic	S (	c- Both a and b	d- None of the above			
10	- If a link is in a com	plex motion, the ori	entation and the	translation of th	e link will be			
	a- constant	b- variable	c- Bo	th a and b	d- None of the above			
11- Links can be classified depending upon their type of connections into								
	a- binary	b- ternary	c- quaternary		d- none of the above			
12- A motor gear has 60 teeth and rotates at 100 rev/min. The driven gear has 30 teeth is connected through								
	a 50 teeth gear to the driver to have the same direction of the driver. The driven rotational speed wi							
	beof the	driver speed.						
	a- twice	b- half	c- equal		d- none of the above			
13-In gear train, the axis of the first and the last gears are co-axial and used clocks.								
	a- simple	b- compound	c- r	everted	d- planetary			
14	- To transfer power b	etween two rotating	shafts with dista	ance between the	em equal to 2 meters, the			
	belt is more desirab	le.						
	a- Flat	b- V-shape	C (	circular	d- timing			
15	The belt is mo	ostly used in where a	moderate amou	nt of power is to	be transmitted from one pulley			
	to another.							
	a- Flat	b- V-shape	C- (	circular	d- timing			
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♦ The impedance of the RLC circuit operating on alternating current is given by the equation:

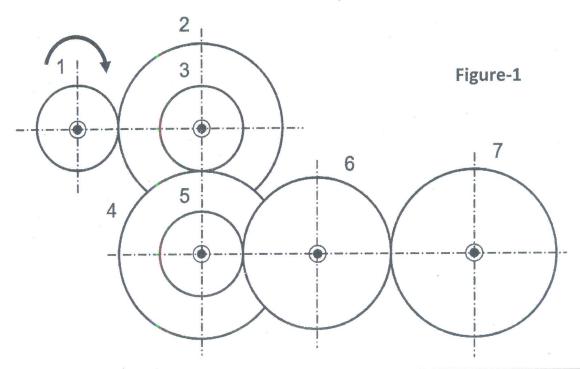
$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

If the uncertainty in each of R, L, and C is 10%, calculate the uncertainty in the measurement of Z. The resistance R is given as  $4 k\Omega$ , the inductance L is 0.16 H, and the capacitance C is  $10\mu F$ . Determine the error in the impedance. ( $X_L = \omega L = 2\pi f L$ ,  $X_C = \frac{1}{2\pi f C}$ , f = 60 Hz)

### Question No. (4):

## [10 Marks]

Determine the speeds and directions of rotation of all the gear wheels in the gear train illustrated in Figure-1 given that gear wheel 1 rotates at 1200 rpm, clockwise. The numbers of teeth on each gear wheel are given in Table-1 shown below. Tabulate your results. (الكتب إجابتك في جدول)



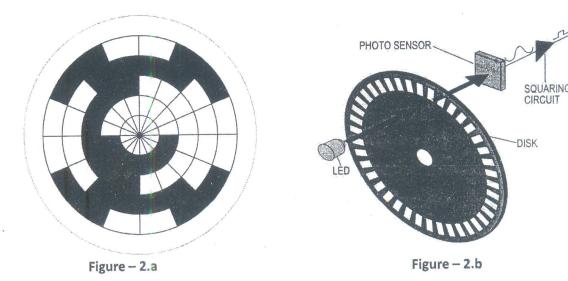
Gear Wheel	Number of Teeth	Gear Wheel	Number of Teeth
1	22	5	26
2	40	6	42
3	24	7	44
4	4 44		7

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- A. A strain gauge is bonded to a beam of 200 mm long and having a cross-sectional area of 10  $cm^2$ . Young's modulus for steel is 500 GPa. The strain gauge has an unstrained resistance of 480  $\Omega$  and a GF of 4. When a load is applied, the resistance of gauge changes by  $0.02\Omega$ .
- > Find the change in length of the steel beam and the amount of force applied to the beam.

B. Figure-2 shows the two types of the optical encoder used for position measurements:

(10 Marks)



Consider that white color slot is represented by zero (0) and black color slot is represented by one (1).

- 1. What is the type of the encoder in part-a and part-b of the figure?
- 1. Write the equation used for calculation of the resolution of the two encoders?
- 2. How many tracks and bits used in the encoder shown in part-a?
- 3. Which type of codes is used in the encoder shown in part-a? Why?
- 4. Write down the table of the code used with the description of angles?

End of Question

With My Best Wishes

Dr. Osama Elshazly