Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20
Course Code: ECE 402
Course Name: BIOMEDICAL INSTRUMENTATION
Program &Sem: B.Tech. (ECE) & VII OE

Date: 30.09.2019
Time: 01:00PM to 02:00PM
Max Marks: 40
Weightage: 20%

Instructions:

i. Read the question properly and answer accordingly.
ii. Question paper consists of 3 parts.
iii. Scientific and Non-programmable calculators are permitted.

Part A (Memory Recall Questions)

Answer all the Questions. Each Question carries four mark. (3Qx4M=12M)

1. List the physiological systems of the body. (C.O.NO.1) [Knowledge]

2. Define Biomedical Instrumentation. Outline any two parameters measured in cardiovascular system. (C.O.NO.1) [Knowledge]

3. Discuss the classification of transducer. (C.O.NO.1) [Knowledge]

Part B Part B (Thought Provoking Question)

Answer all the Questions. Each Question carries seven mark. (2Qx7M=14M)

4. Explain the block diagram of recording system and list the general considerations required in signal conditioning circuits. (C.O.NO.1) [Comprehension]

5. Describe the working principle of potentiometric transducer. (C.O.NO.1) [Comprehension]

Part C (Problem Solving Questions)

Answer the Question. Each Question carries fourteen mark. (1Qx14M=14M)

6. Describe the block diagram of biomedical instrumentation with a neat diagram. (C.O.NO.1) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 7

Course Code: ECE402

Course Name: Biomedical Instrumentation

Date: 30/09/2019

Time: 1.00PM – 2.00PM

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	1	1		4								4
2	1	1		4								4
3	1	1		4								4
4	1	1					7					7
5	1	1					7					7
6	1	1					14					14
	Total Marks			12			28					40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guide lines. Geetha K]

Reviewers' Comments (1) Code in QP
(2) Q5 Any in Scheme

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: 7

Course Code: ECE402

Course Name: Biomedical Instrumentation

Date: 30/09/2019

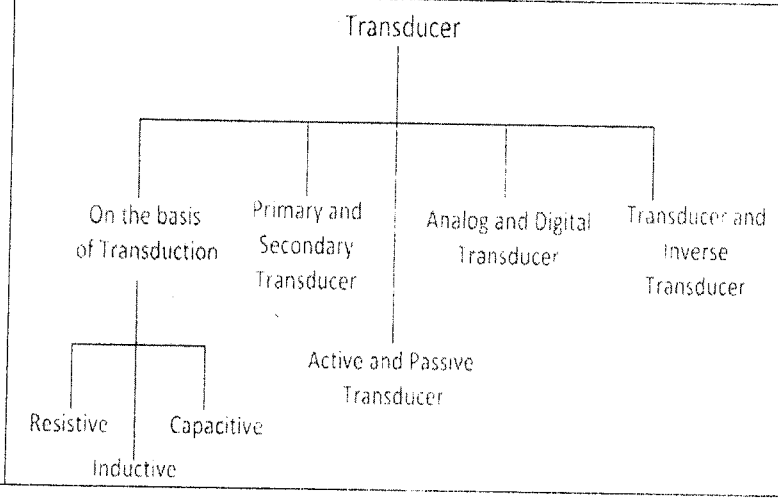
Time: 1.00PM – 2.00PM

Max Marks: 40

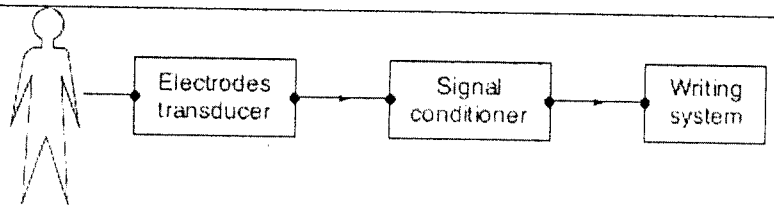
Weightage: 20%

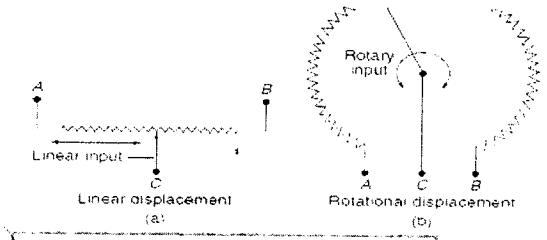
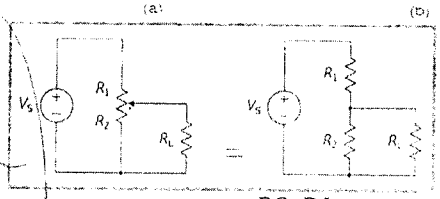
Part A (3Q x 4M = 12Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	• Cardiovascular system • Excretory system • Respiratory system • Digestive system • Reproductive system • Central nervous system • Muscular system	Any 4 1x4=4M	5
2	Biomedical instrumentation and engineering is the Application of knowledge and Technologies to solve problems related to living biological systems. Used in Diagnosis Treatment and Prevention of disease in human. It involves measurement of biological signals like ECG, EMG, etc Or any electrical signals generated in the human body.	Definition 2M Any two 1x2=2M	5

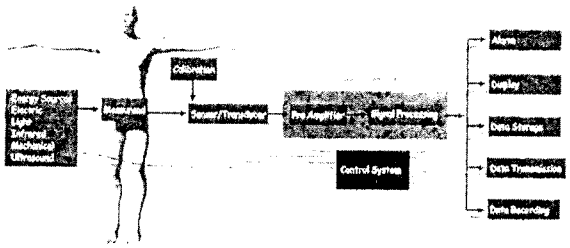
3		Each classification 1M 1x4M=4M	5

Part B (2Q x 7M = 14Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	 Explanation • Signal Amplification • Frequency Response • Filtering • Isolation • Excitation • Linearization	Block Diagram 1M Explanation 3M General consideration any three 3M	12

	  $VL = Vs \frac{R2\,RL}{(R1RL + R2RL + R1R2)}$ Explanation	Equation 1M Explanation 4M	

Part C (1Q x 14M = 14Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6		Diagram 6M Explanation 8M	21

Roll No.													

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20 | **Date**: 18.11.2019

Course Code: ECE 402 | **Time**: 1.00 PM to 2.00 PM

Course Name: BIO MEDICAL INSTRUMENTATION | **Max Marks**: 40

Program & SEM: B.Tech (CSE,ECE,EEE,MEC) & VII (OE) | **Weightage**: 20%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted

---

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries four marks. (3Qx4M=12M)

1. Define patient monitoring system. List the objectives of it. (C.O.2) [Knowledge]

2. Define the following terms (C.O.2, C.O.3) [Knowledge]

(i) Polarization (ii) Depolarization (iii) Heart rate (iv) stroke volume

3. Describe in brief how heart is pumping the blood in two stages. (C.O.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries seven marks. (2Qx7M=14M)

4. A permanent magnet or electromagnet positioned around the blood vessel generates a magnetic field perpendicular to the direction of the flow of the blood. From the given principle of operation

(i) Identify the type of flow meter

(ii) Explain the same with a neat diagram (C.O.2) [Comprehension]

5. Explain in detail water seal spirometer. (C.O.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carry fourteen marks. (1Qx14M=14M)

6. a) Explain briefly Bedside patient monitoring systems with a neat block diagram.

[10M] (C.O.2) [Comprehension]

b) The pattern of the electrocardiogram is as shown in Fig 1.Explain the characteristics of each wave. [4M] (C.O.3) [Comprehension]

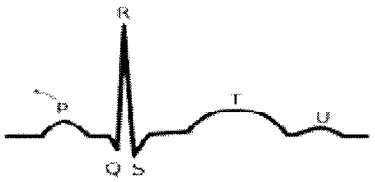


Fig 1

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

Semester: VII

Course Code: ECE 402

Course Name: Bio Medical Instrumentation

Date: 18th November

Time: 1 hr

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			C			
1	C.O.2	Module2	4M	k	-	-	-	-	-	-	-	4
2	C.O.2, C.O.3	Module2,3	4M	k	-	-	-	-	-	-	-	4
3	C.O.3	Module3	4M	k	-	-	-	-	-	-	-	4
4	C.O.2	Module2	-	-	-	7M	C	-	-	-	-	7
5	C.O.2	Module2	-	-	-	7M	C	-	-	-	-	7
6	C.O.2, C.O.3	Module2,3	-	-	-	-	-	-	10 +4 M	C	-	14
	Total Marks											40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines. [Ms. NANDITHA H G]

Neatly Done. Equal Distribution.

12/11/2019

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: VII

Course Code: ECE402

Course Name: Bio Medical Instrumentation

Date: 18th November

Time: 1hr

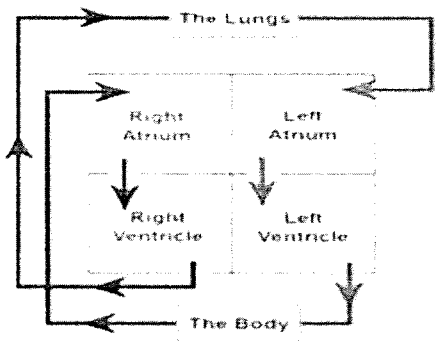
Max Marks: 40

Weightage: 20%

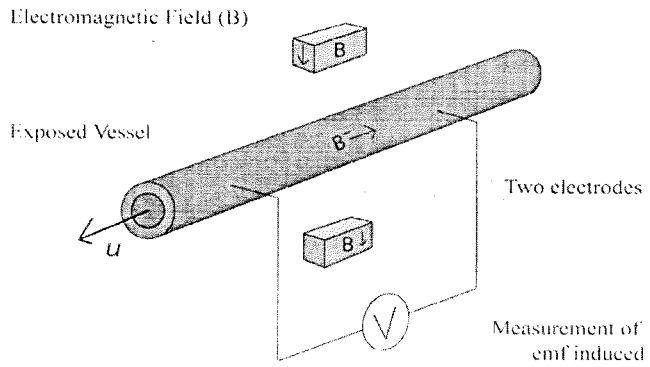
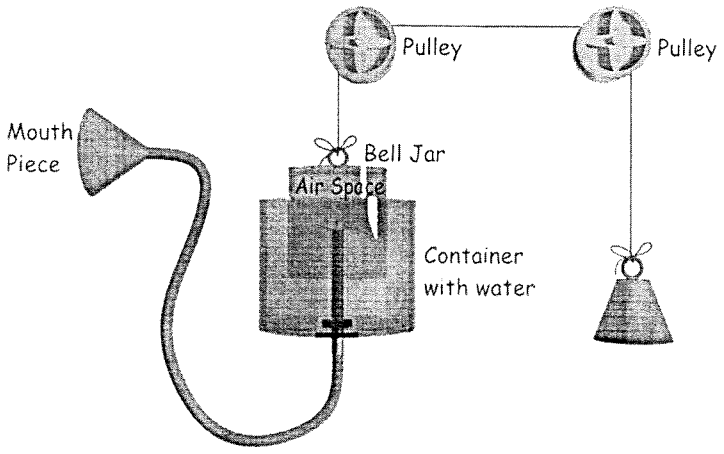
Part A (3x 4 =12 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question

1	• Used for measuring
	  • Continuously or at regular intervals
	  • Automatically
	  • The values of the patients important physiological parameters.
	
	Objectives
	• Organizing and displaying information in a form meaningful for improved patient care
	• Correlating multiple parameters for clear demonstration of clinical problems
	• Processing the data to set alarms on the development of abnormal conditions
	• Providing information based on automated data recording therapy
	• Ensuring better care with fewer staff members
		2+2	5

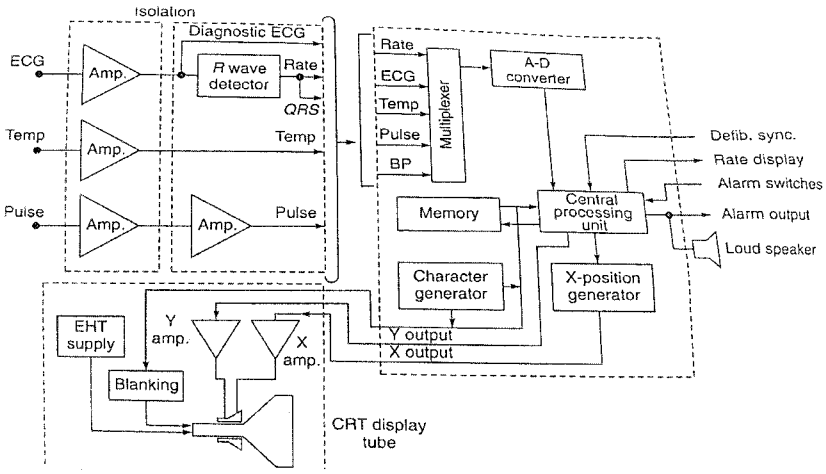
2	The principal ions are sodium (Na+) Potassium (K+) and chloride (Cl-). The membrane of excitable cells permits entry of Potassium (K+) and chloride(Cl-) ions but blocks the entry of sodium (Na+) ions. So inside the cell is more negative than outside cell. This membrane potential is called Resting potentials. This potential is measured from inside the cell with respect to body fluids. So resting potential of a cell is negative and is approximately -90mV, Cell in the resting state is called polarized cell. When a section of a cell membrane is excited by the flow of ionic current or by some form of externally applied energy, the membrane allows flow of Na+ inside of the cell and tries to reach some balance of potential. Same time few K+ ions moves outside but not rapidly like sodium. As a result, the cell has slightly positive potential on the inside due to the imbalance of the Potassium ions. This potential is known as "action potential" and is approximately +20 mV. A cell that has been excited and that displays an action potential is said to be depolarized and process from resting to action potential is called depolarization. It is given as the speed at which heart beats. It is calculates the contractions per minute (bpm). During each ventricular contraction, blood flows through arteries. The flow is detected as one pulse. Heartbeat is affected due to various external factors like age, diseases, exercise, temperature and emotions. Stroke volume is defined as amount of blood being pumped regularly from left ventricle per beat. Factors affecting stroke volume are blood volume in the body, heart contractility and resistance level from blood vessels. Every change in stroke volume affects the blood pressure.	**1+1+1+1**	**6**
3	One of the two stage pump (Right side) collect fluid from the system and pump it through oxygenation system (Lungs). Other side pump receives blood from oxygenation system (Lungs) and pump blood to main hydraulic system. Blood acts as communication and supply network for all parts of the body  	**2+2**	**6**

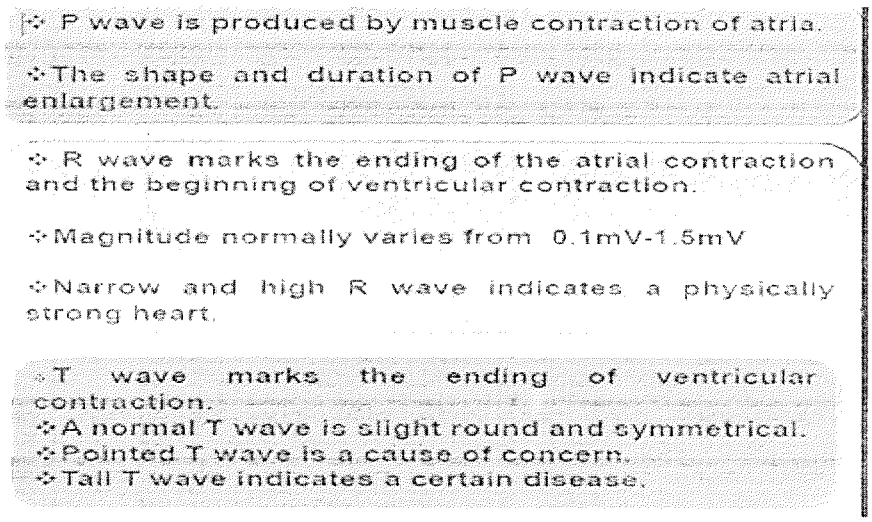
Part B (2 x 7 =14Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4	ELECTROMAGNETIC FLOWMETER  •A permanent magnet or electromagnet positioned around the blood vessel generates a magnetic field perpendicular to the direction of the flow of the blood. • Voltage induced in the moving blood column is measured with stationary electrodes located on opposite sides of the blood vessel and perpendicular to the direction of the magnetic field. • The Induced emf $e = \int_0^L u \times B.dL$ • Where • B = magnetic flux density, T • L = length between electrodes, m • u = instantaneous velocity of blood, m/s This method requires that the blood vessel be exposed so that the flow head or the measuring probe can be put across it as shown in fig.	1+3+2+1	10
5	 It consists of an upright, water-filled cylinder of capacity 6 to 8 liters. Inside the cylinder, an inverted weighted bell jar is attached. The breathing piping	3+4	7

	arrangement from the bottom of the water-filled container is projected above the water level inside the bell jar as shown below. When a person breathes into the bell through the breathing pipe, the volume of air trapped inside it gets changed. The changing air volume gets converted into vertical motion of the bell jar and hence the position of hanging weight changes accordingly. This is because another end of the string attached to the bell jar is attached with the weight via pulleys. The patient breathes air into the tube via the mouthpiece. During each cycle of inhalation and exhalation, the jar moves up and down. It depends on the volume of air inhaled or exhaled into or from the air inside the jar. The weight attached to the string moves up and down depending on the movement of the bell jar. A pen is attached to the weight, which draws the graph on the paper attached to a rotating drum. The graph produced is known as Kymograph. The vertical movement of the weight can be converted to the electrical signal to produce a display on the instrument screen. In that case, a linear potentiometer is attached to the weight to produce the electrical signal corresponding to the weight movement. Resultant graph is Kymograph. Spirometer is considered as mechanical integrator. Input is airflow and volume displacement is the output		

Part C (1 x 14 =14 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6a	 They are used to monitor ECG waveform, heart rate. They also include instrument for pulse, pressure, temperature and respiratory rate monitoring facilities Cardiac monitors: the cardiac monitor is specifically useful for monitoring patients with cardiac problems and the special areas in the hospitals where	6+4	15

	they are used are known as cardiac care unit or coronary care unit CCU. These instruments are also called as cardio-scopes. It comprises of • Disposable type pre-gelled electrodes to pick up the ECG signal • Amplifiers and CRT for the amplification and display of ECG which enables direct observations of waveform • A heat rate meter to indicate average heart rate with audible beep or event of abnormalities occurring in the heart rate. Central monitors: with central monitoring the measured values are displayed and recorded at a central station. Usually, the Signal conditioners are mounted at the bedside and the display and alarms etc are located in a central station. The central station monitoring equipment may incorporate a multiprocessor architecture to display a flexible mixture of smooth waveforms, alphanumeric and graphics on a single CRT. This presents all the information at a glance and thus assists the hospital staff. Central stations are primarily designed for coronary care patient to display ECG waveform and heart rate information for eight patients.		
6b	• The "P" wave is called base line or isopotential line. • P wave ----- De polarization of Auricles. • Combined QRS wave---- Re-polarization of atria and depolarization of ventricles • T wave ----- Ventricular re polarization  1. PR Interval • Time taken by the impulse to travel from atria to AV node. • It's the autrio-ventricular conduction time. • Measured from the onset of the P wave to onset of the QRS complex. • Duration is from 0.12 to 0.20 sec. • Prolonged PR interval>0.20 secs is first degree heart block. 2. QRS Complex	1+1+1+1	5

	• Represents the time taken by the heart impulse to travel first through the intro-ventricular system and then through the free walls of the ventricles. ventricular contraction • Measured from the onset of Q wave to end of S wave. • Duration is between 0.05 and 0.10 secs. • Amplitude is 1 mv • Since the ventricles contain greater muscle mass than the atria, the QRS complex is larger than the P wave.		

Roll No												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: ECE 402
Course Name: BIOMEDICAL INSTRUMENTATION
Program & Sem: BTech(CSE/ECE/EEE/MEC) & VII (OE-II)

Date: 26 Dec 2019
Time: 9.30 AM to 12.30 PM
Max Marks: 80
Weightage: 40%

Instructions:
(i) Read the all questions carefully and answer accordingly.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. (10Qx2M=20M)

1. Mention two examples of transducer (C.O.No.1) [Knowledge]
2. Name any two passive transducer (C.O.No.1) [Knowledge]
3. List objectives of patient monitoring system (C.O.No.2) [Knowledge]
4. What is the unit and typical value of blood pressure? (C.O.No.2) [Knowledge]
5. What are the different types of lead configuration used in ECG? (C.O.No.3) [Knowledge]
6. In EEG measurement F_z and P_3 stands for (C.O.No.3) [Knowledge]
7. What are the application of surface electrode and needle electrode? (C.O.No.3) [Knowledge]
8. Name any two imaging technique used in medical field (C.O.No.4) [Knowledge]
9. Mention any two properties of X Ray. (C.O.No.4) [Knowledge]
10. What are the application of CT scanning? (C.O.No.4) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 7 marks. (4Qx7M=28M)

11. It is found that patient is suffering from high fever with varying body temperature, suggest any two temperature sensors that can be used, and explain the principle used behind these sensors. (C.O.No.1) [Comprehension]

12. Name the devices used for indirect blood pressure measurement. Explain the principle of operation of indirect blood pressure measurement. (C.O.No.2) [Comprehension]

13. Which electrode placement technique uses less number of electrodes in EEG measurement? Explain the placement of electrode in this scheme.

(C.O.No.3) [Comprehension]

14. Name the simplest display used in ultrasound measurement. Explain the block diagram of the same. (C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 8 marks. (4Qx8M=32M)

15. Describe the block diagram of Biomedical instrumentation system

(C.O.No.1) [Comprehension]

16. What is patient monitoring system? Explain the types of patient monitoring system

(C.O.No.2) [Comprehension]

17. Describe the block diagram of EEG machine (C.O.No.3) [Comprehension]

18. Explain the working of X ray Tube. (C.O.No.4) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	A	
1.	1	1	2			2
2.	1	1	2			2
3.	2	2	2			2
4.	2	2	2			2
5.	3	3	2			2
6.	3	3	2			2
7.	3	3	2			2
8.	4	4	2			2
9.	4	4	2			2
10.	4	4	2			2
11.	1	1		7		
12.	2	2		7		
13.	3	3		7		
14.	4	4		7		
15.	1	1		8		
16.	2	2		8		
17.	3	3		8		
18.	4	4		8		

	Total Marks	20	60		80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Comment:

(1) Thought Provoking Questions must be set as per guidelines, next sem onwards.

(2) No Application level question.

Note: For point no. (2), faculty replied that as per CO coverage and syllabus taught, no numerical examples needed.

Format of Answer Scheme

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SOLUTION

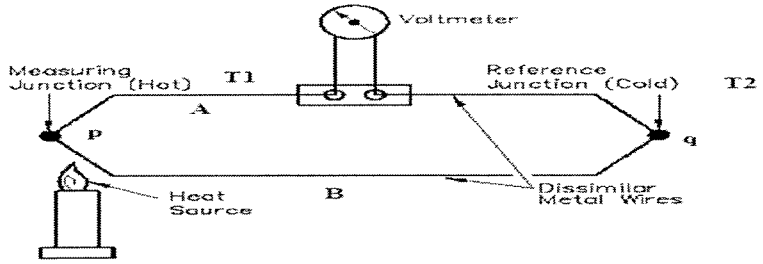
Semester: Odd Sem. 2019-20
Course Code: ECE402
Course Name: BIOMEDICAL INSTRUMENTATION
Program & Sem: BTECH/CSE/ECE/EEE/MEC/7TH SEM

Date: 26.12.2019
Time: 3 HRS
Max Marks: 80
Weightage: 40%

Part A (10Q x 2M = 20Marks)

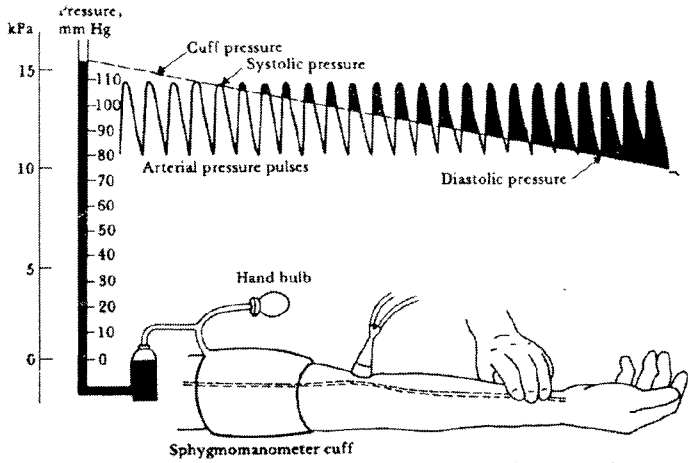
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1.	Thermistor, thermocouple, RTD etc	Each 1=1x2=2M	3
2.	Resistive, capacitive, inductive	Each 1=1x2=2M	3
3.	Organizing and displaying information in a form meaningful for improved patient care Correlating multiple parameters for clear demonstration of clinical problems	Each 1=1x2=2M	3
4.	mmhg, 120/80	Each 1=1x2=2M	3
5.	Unipolar, bipolar	Each 1=1x2=2M	3
6.	Frontal centre, parietal left side	Each 1=1x2=2M	3
7.	ECG, EEG	Each 1=1x2=2M	3
8.	X ray, CT Scan, MRI, Ultrasound	Each 1=1x2=2M	3
9.	Ionize gases, penetrates matter, straight line	Each 1=1x2=2M	3
10.	Measuring mineral density, study of lungs and abdomen, diagnosing heart disease	Each 1=1x2=2M	3

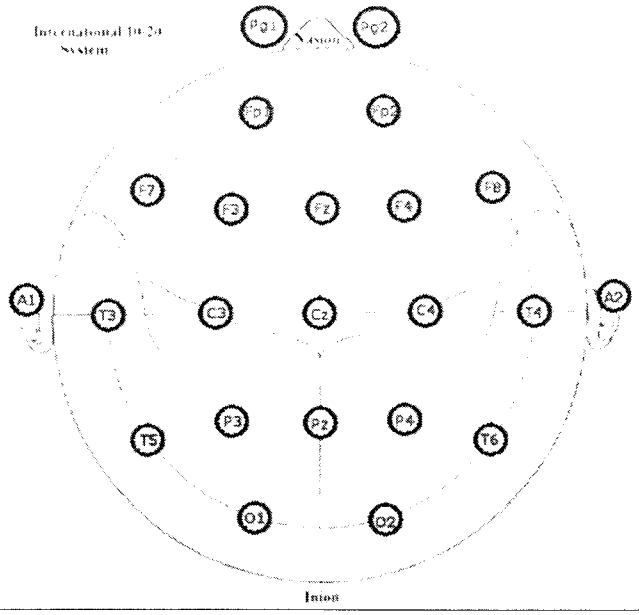
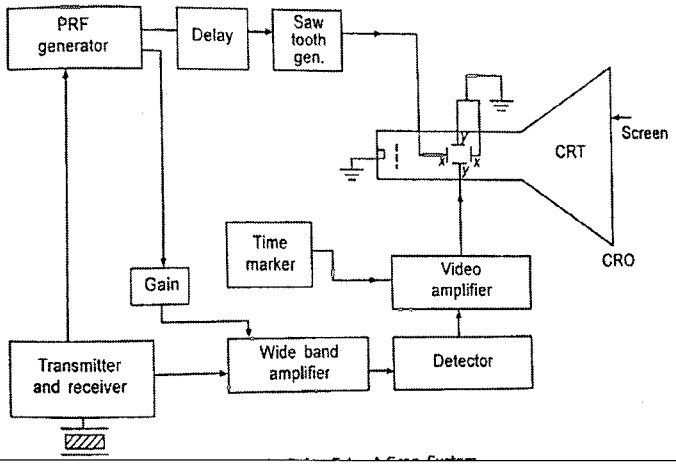
Part B (4Q x 7M = 28 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
11.	**Thermocouple** **Principle:** If two wires of dissimilar metals are joined at both ends and one end is heated, current will flow this effect is known as Seebeck effect. If the circuit is broken, there will be  **Thermocouple Circuit** an open circuit voltage across the wires. **Thermocouple** made by two different metal wires joined at one end, this joint end is placed in a temperature zone where temperature should be measured called "hot zone" and the other end of thermocouple where two metal wire are open (not connected or joined) placed in a low room temperature called "cold zone or reference temperature" as shown in the figure. Now as two ends of this metal pair are placed in two different temperature zone. A net thermoelectric voltage is generated according to the temperature difference between two ends. **This voltage is measured in the open pair placed in cold zone or reference zone.** Voltage is a function of temperature and metal types. For small ΔT change in temperature, the relationship with temperature is linear and is given by $\Delta V=\alpha\Delta T$ **THERMISTORS** The Thermistor works on a simple principle: Change in temperature of the Thermistor, leads to a change in its resistance. The Thermistor's temperature can change either due to external factors or due to internal factors. The most important internal factor is the current flowing through the device. As the current through it increases, it starts self-heating its elements. This causes a rise in temperature of the Thermistor. The thermistor is negative temperature coefficient transducer ie, its resistance decreases with increase in temperature and vice versa.	Identification 1M Principle each 3M 1+3+3=7M	17.5 minutes

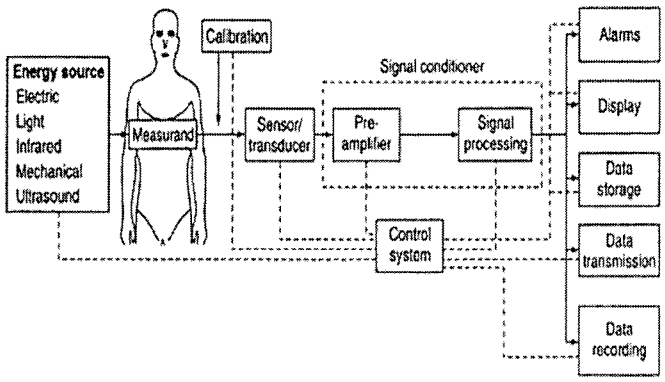
	The resistance and temperature relationship can be approximated by the following equation:
	
	• $R = Ae^{B/T}$
	  • R = resistance of the thermistor in Ω
	  • T = absolute temperature
	  • A and B are constants
	
	RTD transducer
	
	The working of the RTD sensor is based on the resistance-temperature relationship of the material used for its construction. The amount of change seen in the resistance value of the material caused due to per degree rise in temperature is measured and the sensor is calibrated accordingly.
	
	The resistance of the RTD is given by
	
	• Rt = Ro(1 +at)
	• Where Ro = resistance at 0°C and
	• a = temperature coefficient of resistivity
	
	Below graph shows the characteristics of RTD, Thermocouple and Thermistor		

12.	sphygmomanometer The instrument used to measure blood pressure is known as. A stethoscope and an inflatable pressure cuff is required in this method A pressure cuff is wrapped on the upper arm and is first inflated to a pressure well above the systolic pressure. At this point no sound can be heard through the stethoscope, which is placed over the brachial artery as artery has been collapsed by the pressure of the cuff. The pressure in the cuff is then gradually reduced. When the systolic peaks are higher than the occlusive pressure, the blood spurts under that cuff and audible sounds (Korotkoff sound, named after Dr. Nikolai Korotkoff) generated by the flow of blood and vibrations of the vessel under the cuff are heard through the stethoscope below the arm. The pressure of the cuff that is indicated on the manometer when the first Korotkoff sound is heard is recorded as the systolic blood pressure. As the pressure in the cuff continues to drop, the Korotkoff sounds continue until the cuff pressure is no longer sufficient to occlude the vessel during any part of the cycle. Below this	Device name 1M Construction details with figure 4M Working 2M	17.5 minutes

	pressure the Korotkoff sounds disappear, marking the value of the diastolic pressure. Ausculatory (based on the Korotkoff sounds) technique is simpler and requires a minimum of  equipment but it cannot be used in noisy environments. This method of indirect blood pressure measurement is known as Ausculatory method: In Palpation method stethoscope is placed on wrist and is based on pulse on the blood vessel. This technique doesn't require a noise free environment.		
13.	The electrodes are placed on the scalp using **10-20 electrode** placement system devised by a committee of the International Federation of Societies for Encephalography. It is so named because electrodes are placed at intervals of10% and 20% of the distance between specified points on the scalp. The electrodes are identified according to their position on the head: Fp for frontal polar, F for frontal, C for central, P for parietal, T for temporal and O for occipital. Odd and even numbers refer to electrodes on left and right side of head respectively. Z denotes midline electrodes. Ground reference electrode is a metal clip on the earlobe. 19 electrodes are used on scalp and 1 for grounding. Draw a line on the skull from the root of the nose(nasion) to the inion (bump on the occipital lobe) Draw a line from the left preauricular (ear) point to the right preauricular point. Mark the intersection of these two lines as CZ. Mark points at 10,20,20,20 and 10% of the total nasion-inion distance. The points are marked Fpz, Fz, Cz, Pz and Oz. Mark points at 10,20,20,20 and 10% of the total distance between preauricular points. The points are marked T3, C3, Cz, C4 and T4.	Identification 1M Diagram 2M Explanation 4M	17.5 minutes

			
14.		Diagram 4M Explanation 3M	17.5 minutes

Part C (4Q x 8M = 32Marks)

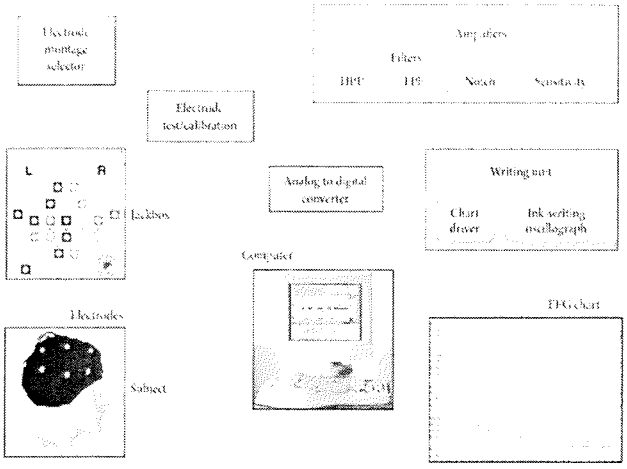
Q No	Solution	Scheme of Marking	Max. Time required for each Question
15.	 Energy Source: Used to energize the whole instrumentation system. Examples: Different sources used are electric, light, infrared, mechanical and ultrasound	Diagram 4M Explanation 4M	20 minutes

	2. Measurand: The physical quantity, property, or condition that the system measures is called measurand. Examples: Internal (Blood Pressure), On the Body Surface (Electrocardiogram), Emanate from the body (Infrared Radiation), Derived from Tissue Sample (such as Blood or a Biopsy) 3. Sensor / Transducer: The transducer is defined as a device that converts one form of energy to another. A sensor converts a physical measurand to an electric output. 4. Signal Conditioning: Simple signal conditioners may only amplify and filter the signal or merely match the impedance of the sensor to the display. Often sensor outputs are converted to digital form and then processed by specialized digital circuits or a microcomputer. For example, signal filtering may reduce undesirable sensor signals. It may also average repetitive signals to reduce noise, or it may convert information from the time domain to the frequency domain. 5. Output Display: The results of the measurement process must be displayed in a form that the human operator can perceive. The best form for the display may be: a. Numerical b. Graphical, c. Displacement, d. CRT e. Visual / Hearing The processed signal after conditioning passed through a) Alarm System: Indicate when measurand goes beyond a preset limit. b) Data Storage: To maintain the data for future reference c) Data Transmission: Used to transmit the information obtained from one location to another. 6. Auxiliary Components a) Calibration: some form of calibration is		

	necessary at regular intervals during the operation of instruments. The calibration signal is usually applied to the sensor input or in the signal conditioning. Control and Feedback Signal: Required to bring out the measurand, to adjust the sensor and signal conditioner, and to direct the flow of output for display, storage or transmission. The control and feedback may be automatic or manual.		
16.	Patient Monitoring System are used for measuring continuously or at regular intervals, automatically, the values of the patients important physiological parameters. Patients who may need continuous monitoring or intensive are basically critically ill patients recovering from the surgery, heart attack, and serious illness. ECG, Heart rate, Pulse rate, Blood pressure, Body temperature, Respiratory rate are the parameters commonly measured in patient monitoring systems **Bedside Patient Monitoring System:** they are used to monitor ECG waveform, heart rate. They also include instrument for pulse, pressure, temperature and respiratory rate monitoring facilities **Cardiac monitors:** the cardiac monitor is specifically useful for monitoring patients with cardiac problems and the special areas in the hospitals where they are used are known as cardiac care unit or coronary care unit CCU. These instruments are also called as cardio-scopes. It comprises of • Disposable type pre-gelled electrodes to pick up the ECG signal • Amplifiers and CRT for the amplification and display of ECG which enables direct observations of waveform • A heat rate meter to indicate average heart	Definition 2M Each 2Mx3=6M	20 minutes

	rate with audible beep or event of abnormalities occurring in the heart rate. **Central monitors:** with central monitoring the measured values are displayed and recorded at a central station. Usually, the Signal conditioners are mounted at the bedside and the display and alarms etc are located in a central station. The central station monitoring equipment may incorporate a multiprocessor architecture to display a flexible mixture of smooth waveforms, alphanumeric and graphics on a single CRT. This presents all the information at a glance and thus assists the hospital staff. Central stations are primarily designed for coronary care patient to display ECG waveform and heart rate information for eight patients.		
17.	Montages are patterns of connections between the electrodes and the recording channels. The montage selection switch is used for selecting a particular channel. Different channels convey different information. Montages are always symmetrical and hence in the 10-20 electrode placement system the electrodes are also placed symmetrically. The EEG signals are transmitted from the electrodes to the montage selector panel. The montage selector of an EEG machine is a large frame which consists of different switches so as to allow the user to select the desired electrode pair. 2) Pre-amplifier	Diagram 4M Explanation 4M	20 minutes

The function of pre-amplifiers in the EEG measuring system is clear from the name itself. As the EEG



signals are having amplitude levels in microvolt range it is compulsory that they are to be amplified before further processing. It is to ensure that the information from the EEG electrodes is not affected by any external noise. We normally use high gain, high CMRR operational amplifiers as preamplifiers due to its versatile features.

3) Filters and amplifiers

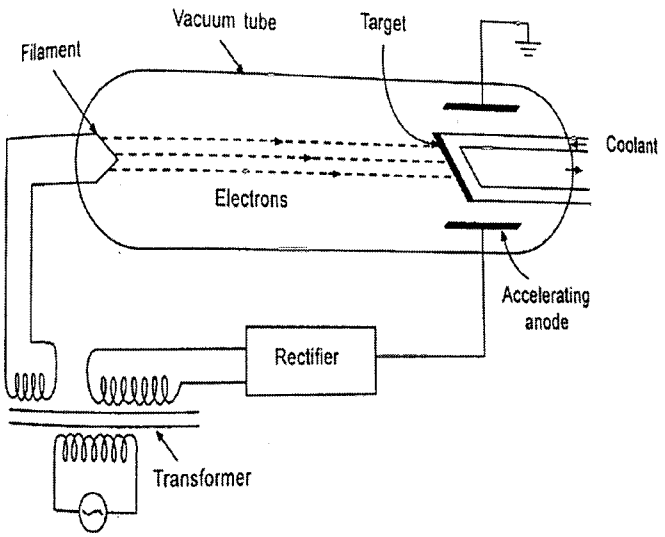
The muscle artifacts (noise) are a major problem regarding the EEG waveform. These noises can make the representation dishonest. So we have to filter out these noise contents. This function is done by a bank of filters in the EEG machine systems, which are selected according to the need. Amplifiers are used here also to improve the amplitude levels of EEG waveform

4) Analog to Digital Converters (ADC)

For the detailed analysis of the EEG waveform, we use computers and oscilloscopes. As the computers only accept digital data we have to convert the analog EEG information in to digital form. The function of ADC is to convert the analog EEG signal to digital form. Thus the computer can store the EEG waveform for future reference.

5) Writing recorder and paper drive

The writing part of an EEG machine is usually consists of an ink type direct writing recorder. The recorder will be a chart paper which is driven by a synchronous motor. For the clear representation of the EEG waveform an accurate and stable paper

	drive mechanism is provided by the synchronous motor. Also there are provisions to control the paper speed.		
18.		Diagram 4M Explanation 4M	20 minutes