MUTHAYAMMAL ENGINEERING COLLEGE
(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

MUST KNOW CONCEPTS

MKC

BME

2021-22

Subject	19BMC12 – BIOMEDICAL INSTRUMENTATION			
UNIT-1 PHYSIOLOGICAL TRANSDUCERS				
S.No	**Term**	**Notation (Symbol)**	**Concept/Definition/Meaning/Units/Equation/Expression**	**Units**
1	Transducer	-	A transducer is any device that converts one form of energy into a readable signal.	-
2	Classification of Transducer	-	The transducer is classified as the active and passive transducer	-
3	Active transducer	-	In transducer, the active transducers generate electric current or voltage directly without any external source. Ex.: thermocouple, Photovoltaic cell	-
4	Passive Transducer	-	Passive transducer is a device which converts the given non-electrical energy into electrical energy by external force. Ex.: Resistance strain gauge, Differential Transformer	-
5	Performance Characteristics of Transducer	-	✓ Sensitivity. ✓ Linearity. ✓ Resolution. ✓ Precision (Accuracy) ✓ Span and Range. ✓ Threshold. ✓ Drift. ✓ Stability.	-
6	Pressure Transducer	-	A pressure transducer is a measuring device which converts an applied pressure into an electrical signal.	-
7	Transducer for body temperature measurement	-	Thermistor – Thermal Resistor A thermistor is a resistance thermometer, or a resistor whose resistance is dependent on temperature. The term is a combination of “thermal” and “resistor”	-

8	Photoelectric Transducer	-	The photoelectric transducer is a light-sensitive device used to convert light energy into electrical energy. It is made up of semiconductor material that emits electrons when a beam of light falls on it.	-
9	Optical fiber sensor	-	A sensor that uses optical fiber either as the sensing element, or as a means of relaying signals from a remote sensor to the electronics that process the signals.	-
10	Optical Fiber	-	Fiber optics, or optical fiber, refers to the technology that transmits information as light pulses along a glass or plastic fiber	-
11	Sensor	-	A device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine.	-
12	Biosensor	-	An analytical device, used for the detection of a chemical substance that combines a biological component with a physicochemical detector.	-
13	Smart sensor	-	A device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on.	-
14	Biomedical Recorders	-	Recorders provide permanent visual trace or record of an applied electrical signal. Components are Transducer, signal conditioner and writing system. Ex.: Inkjet Recoder, Galvanometric Recorder	-
15	Biofeedback Instruments	-	Combination of highly sophisticated physiological recording equipment and audio and visual teaching display systems.	-
16	Patient Monitoring System	-	Monitoring of patients vitals remotely by means of devices that transfer patient data to remote locations wirelessly.	-
17	Concept of PMS	-	To give warning of early or dangerous deterioration and to achieve this by obtaining an optimal compromise involving many design factors, clinical, engineering and economic.	-
18	Types of PMS	-	Though there are many types of patient monitoring systems (e.g., wireless, portable, real-time, continuous, etc.) they are typically sorted into two broad categories: bedside patient monitoring systems and remote patient monitoring systems.	-
19	Cardiac Monitor	-	A device that you control to record the electrical activity of your heart (ECG). This device is about the size of a pager. It records your heart rate and rhythm.	-

20	Bedside Patient Monitoring System	-	A display of major body functions on a device that looks like a television screen or computer monitor. The number of body functions the monitor measures is up to the doctor and nurse. The monitor is attached to wires, called leads.	-
21	Central Monitors	-	The central monitoring system is a smart monitoring management system that connects a series of patient monitors together and back to a central monitor(240 hours of patient data, 96 hours of full disclosure and up to 30,000 patients).	-
22	Measurement of Temperature	-	Changes in resistance of the thermistor with changes in temperature are measured in a bridge circuit and indicated on a calibrated meter. The measuring range is 30-42°C	-
23	Measurement of Respiratory	-	The number of breaths a person takes per minute. The rate is usually measured when	-
24	Catheterization	-	• A **catheter** is a thin tube made from medical grade materials serving a broad range of functions. • Catheters are medical devices that can be inserted in the body to treat diseases or perform a surgical procedure. • By modifying the material or adjusting the way catheters are manufactured, it is possible to tailor catheters for cardiovascular, urological, gastrointestinal, neurovascular, and ophthalmic applications. The process of inserting a catheter is "catheterization"	-
25	Catheterization Laboratory	-	A catheterization laboratory, commonly referred to as a cath lab, is an examination room in a hospital or clinic with diagnostic imaging equipment used to visualize the arteries of the heart and the chambers of the heart and treat any stenosis or abnormality found.	-
UNIT -2 OXIMETERS				
26	Oximetry	-	Oximetry refers to the determination of percentage of oxygen saturation of the circulating arterial blood. $\text{Oxygen saturation} = \frac{[HbO_2]}{[HbO_2]+[Hb]}$	-
27	Ear oximeter	-	Ear oximeters usually make use of the transmission principle to measure the arterial oxygen saturation. Blood in the ear must be made similar to arterial blood in composition.	-

28	Pulse oximeter	-	An oximeter that measures the proportion of oxygenated haemoglobin in the blood in pulsating vessels, especially the capillaries of the finger or ear.	-
29	Skin reflectance oximeter	-	A skin reflectance oximeter can be used to measure oxygen saturation level of blood in localized areas of oxygen deprived tissues on the limbs, head and torso. The instrument basically depends on monitoring backscattered light from living tissue in two wavelengths (665nm and 935nm).	-
30	Intravascular oximeter	-	Oximeters that measure the mixed venous blood-oxygen saturation (SvO2) using a catheter that includes optical fibers.	-
31	Blood flow-meters	-	Blood flow-meters are the devices that monitor the blood flow in various blood vessels and measure the cardiac output.	-
32	Electromagnetic blood flow meters	-	Electromagnetic blood flowmeters and flow probes are used to measure blood flow in blood vessels throughout the circulatory system. The principle of this measuring device is based on laws of electromagnetic induction.	-
33	Ultrasonic blood flow meters	-	It is a non-invasive technique to measure blood velocity in a particular vessel from the surface of the body. It is based on the analysis of echo signals from the erythrocytes in the vascular structures. Because of the Doppler effect, the frequency of these echo signals changes relative to the frequency which the probe transmits. The Doppler frequency shift is a measure of the size and direction of the flow velocity.	-
34	Electromagnetic blood flow meters - types	-	❖ Ultrasonic Blood Flowmeter. ❖ Range Gated Pulsed Doppler Blood Flowmeter. ❖ NMR Blood Flowmeter. ❖ LASER Doppler Blood Flowmeter	-
35	NMR blood flow meters	-	Nuclear Magnetic Resonance (NMR) permits the noninvasive measurement of blood flow signals unimpaired by clothes, bandages, casts, etc. The cylindrical crossed-coil NMR blood flowmeter was used to measure blood flow through a cross-section of the human forearm.	-
36	Pulmonary Function - measurements	-	• Ventilation, distribution and diffusion. • Ventilation deals with the measurement of the body as an air pump, determining its ability to move volumes of air and	-

			the speed with which it moves the air. • Distribution measurement provide an indication of where gas flows in the lungs and whether or not disease has close some sections to air flow. • Diffusion measurements test the lung's ability to exchange gas with the circulatory system.	
37	Dead Space	-	Dead Space is the functional volume of the lung that does not participate in gas exchange.	-
38	Cardiac output measurements	-	Cardiac output (CO) is the product of the heart rate (HR), i.e. the number of heartbeats per minute (bpm), and the stroke volume (SV), which is the volume of blood pumped from the ventricle per beat; thus, CO = HR × SV. Values for cardiac output are usually denoted as L/min.	-
39	Indicator dilution method	-	Cardiac output measurement by indicator dilution method is an invasive technique that measures the amount of blood ejected by the heart every minute for peripheral circulation in the whole body	-
40	Dye dilution method	-	The dye dilution method for measuring cardiac output is based on injecting rapidly a known quantity of a dye at one site into the circulatory system, and withdrawing blood at a distal site for determination of a concentration curve of the dye.	-
41	Thermal dilution techniques	-	The thermodilution method involves injection of a definite amount of heat into the bloodstream, and the corresponding downstream temperature change is recorded	-
42	Thermal dilution	-	Relating to or being a method of determining cardiac output by measurement of the change in temperature in the bloodstream after injecting a measured amount of cool fluid (as saline)	-
43	Measurements of continuous cardiac output derived from the aortic pressure waveform	-	Cardiac output (CO) is the product of the heart rate the number of heart beats per minute (BPM) and the stroke volume (sv) which is the volume of blood pumped from the ventricle per beat. Thus CO=HR×SV. Value of cardiac output are usually denoted as L/min	-
44	Impedance technique	-	The impedance method allows us to completely eliminate the differential equation approach for the determination of the response of circuits.	-
45	Pulmonary function analyser	-	Pulmonary function analyzers measure the performance of a patient's respiratory	-

			system, especially for outpatient or presurgical screening. These systems measure the ventilation, diffusion, and distribution of gases in the lungs	
46	Spirometry	-	Common office test used to assess how well your lungs work by measuring how much air you inhale, how much you exhale and how quickly you exhale. Spirometry is used to diagnose asthma, chronic obstructive pulmonary disease (COPD) and other conditions that affect breathing	-
47	Pneumotachometer	-	Airflow can be measured directly with a pneumotachometer and a transducer. A pneumotachometer converts the flow of gases through it into a proportional signal of pressure difference on either side of a central mesh whose design ensures a signal linearity over a range of flow rates with a minimum dead space.	-
48	Residual Volume (RV)	-	The volume of gas remaining in the lungs after a forced expiration.	-
49	Measurement of volume by nitrogen washout technique	-	Nitrogen washout (or Fowler's method) is a test for measuring anatomic dead space in the lung during a respiratory cycle,as well as some parameters related to the closure of airways	-
50	Nitrogen washout treatmeasure	-	Single-breath nitrogen washout test (sometimes called the single-breath oxygen test) is designed to assess the uniformity of gas distribution in the lungs and the behavior of the dependent airways.	-
UNIT -3 BLOOD GAS ANALYZERS				
51	Acid	-	A molecule or other species which can donate a proton or accept an electron pair in reactions	-
52	Base	-	Base is defined as a chemical compound which has a bitter taste and pH value more than 7	-
53	Acid-base balance	-	Acid base balance is refers to the mechanism that the body uses to keep its fluid close to neutral pH (that is neither acidic or basic) so that the body can function normally	-
54	pH	-	PH, quantitative measure of the acidity or basicity of aqueous or other liquid solutions. A solution with a pH less than 7 is considered acidic; a solution with pH	-

			greater than 7 is considered as basic or alkaline	
55	Blood pH measurement	-	Blood pH is a measure of the blood acidity or alkalinity	-
56	Measurement of blood	-	Systolic blood pressure: (the first and higher number) measures pressure inside your arteries when the heart beats. Diastolic blood pressure: (the second and lower number) measures the pressure inside the artery when the heart rests between beats	-
57	Blood gas	-	Blood gases are a group of tests that are performed together to measure the pH and the amount of oxygen (O_2) and carbon dioxide (CO_2) present in a sample of blood	-
58	Intra – arterial blood gas monitoring	-	Continuous arterial blood gas analysis is a real-time monitoring tool, which reliably detects the onset of adverse pulmonary effects	-
59	Blood gas analyzer	-	Blood Gas Analyzers aspirate blood from the syringe and measure pH and the partial pressures of oxygen and carbon dioxide	-
60	Audio meter	-	An audiometer is a machine used for evaluating hearing acuity	-
61	Hearing Aids	-	A hearing aid is a device designed to improve hearing by making sound audible to a person with hearing loss	-
62	Hearing	-	Hearing is the process by which the ear transforms sound vibration in the external environment into nerve impulses that are conveyed to the brain, where they are interpreted as sounds	-
63	Mechanism of hearing	-	Soundwavesentertheouterearandtravelthroughtheexternalauditorycanaluntiltheyreachthetympanicmembrane, causingthemembraneandtheattachedchainofauditoryvesiclestovibrate	-
64	Measurement of sound	-	The measurement of sound involves the analysis of frequency, intensity, and temporal dimensions of acoustic signals	-
65	Sound	-	Sound is avibrationthat propagates as an acoustic waves , through a transmission medium such as a gas, liquid or solid	-
66	Pure - tone audiometer	-	Pure-tone audiometer is a behavioral test used to measure hearing sensitivity	-
67	Speech audiometer	-	Speech audiometer involves two different tests. One checks how loud speech needs to	-

			hear it. The other checks how clearly you can understand and distinguish different words when you hear them spoken.	
68	Bekesy evoked response audiometer system	-	Bekesy is an automatic method of measuring audiometric thresholds. It can be used for audiometric screening or in differentiation between the cause of the hearing loss e.g. non-organic hearing loss	-
69	Bekesy audiometer types	-	Type 1 : Primarily normal function or middle ear disorder Type 2 : Indicates primarily cochlear disorders Type : 3 & 4 indicated primarily eighth nerve disorder	-
70	Parts of audiometer	-	The process of audiometry is quite simple, consisting of three parts: Mechanical sound transmission (middle ear function) Neural sound transmission (cochlear function) Speech discrimination ability (central	-
71	Three types of hearing loss	-	Sensorineural hearing loss, conductive hearing loss, and mixed hearing loss	-
72	Audiogram	-	The audiogram shows the pattern of your hearing loss. It also shows how severe it is, called the degree of hearing loss	-
73	Calibration	-	Calibration is a comparison between a known measurement (the standard) and the measurement using the instrument	-
74	Calibration of audiometer	-	Checking the accuracy of the output of a measuring instrument	-
75	Calibration of hearing aids	-	Thecalibrationprocessessentiallyinvolves testingthedeviceandmakingtheminoradjustments neededtoensureitistailoredtoyourspecific hearingneeds	-
UNIT-4 CARDIAC PACEMAKER AND DEFIBRILLATORS				
76	Cardiac pacemaker	-	By giving external electrical stimulation impulses to the heart muscle, it is possible to regulate the heart rate. These impulses are given by an electronic instrument called a ‘pacemaker’.	-
77	Types of pacemaker	-	The classification of pacemakers into different types is based on the mode of application of the stimulating pulses to the heart. 1.External pacemakers 2.Internal pacemakers	-
78	External pacemaker	-	External pacemakers are used when the heart block presents as an emergency and when it is expected to be present for a short time.	-
79	Internal pacemaker	-	Internal pacemakers are used in cases requiring long-term pacing because of	-

			permanent damage that prevents normal self-triggering of the heart.	
80	Types of pacemaker	-	There are three types of pacemakers based on the type of output waveform. 1.Voltage pacemaker 2.Current pacemaker 3.Current limited voltage pacemaker	-
81	Voltage pacemaker	-	• Voltage pacemakers are those in which the current in the circuit is determined by the available voltage during the entire duration of the impulse. • The voltage output from the pacemaker remains constant and changes of resistance in the circuit will influence only the current.	-
82	Current pacemaker	-	In current pacemakers, throughout the impulse, the current in the circuit is determined by the internal resistance of the pacemaker.	-
83	Current limited voltage pacemaker	-	This is primarily a voltage circuit, but the maximum current in the circuit is limited, preventing too large a current impulse to circulate when there is a low resistance in the electrode circuit.	-
84	Implantable pacemaker	-	• A device that uses electrical impulses to regulate the heart rhythm or to reproduce that rhythm. • It is performed to treat abnormal heart rates or rhythms (arrhythmia), particularly if they have not responded well to drug therapy (medication).	-
85	Types of implantable pacemaker	-	1. Fixed rate pacemaker 2. Demand pacemaker 3. R wave triggered pacemaker 4. Ventricular inhibited or R wave blocked pacemaker 5. Atrial triggered pacemaker 6. Dual chamber pacemaker	-
86	Programmable pacemaker	-	A programmable pacemaker consists of two parts: • The external unit which generates programmed stimuli which is transferred to the internal unit by one of the several communication techniques.	-
87	Methods of transmitting information – programmable pacemaker	-	• Magnetic—an electromagnet placed on the surface of the body establishes a magnetic field which penetrates the skin and operates the pacemaker's reed switch.	-

			• Radio-frequency waves—the information can be transmitted over high frequency electromagnetic waves which are received inside the body by an antenna. • Acoustic-ultrasonic pressure waves from a suitable transducer placed over the skin, can penetrate the human body.	
88	Rate responsive pacemaker	-	It has sensors that detect changes in the patient's physical activity and automatically adjust the pacing rate to fulfill the body's metabolic needs.	-
89	Pacing system analyzer	-	• Pacing system analysers are useful in the operating room or catheterization laboratory during pacemaker surgical procedures. • The analyser can help to determine optimum voltage and pulse width thresholds with the resultant current flow thus helping to determine the stimulation thresholds.	-
90	Defibrillator	-	A defibrillator is a device that gives a high energy electric shock to the heart of someone who is in cardiac arrest. This high energy shock is called **defibrillation.**	-
91	Need for a defibrillator	-	• Due to ventricular fibrillation, there is an irregular rapid heart rhythm. This sudden surge across the heart causes all muscle fibres to contract simultaneously. • The instrument for administering the shock is called DEFIBRILLATOR.	-
92	Types of defibrillator	-	1.Internal defibrillator • Electrodes placed directly to the heart (pacemaker). 2.External defibrillator • Electrodes placed directly on the heart(Automatic external defibrillator).	-
93	Power of defibrillation	-	• Higher voltages are required for external defibrillation than for internal defibrillation. • A corrective shock of 750-800 volts is applied within a tenth of a second.	-
94	Purpose of defibrillation	-	• Defibrillation is performed to correct life threatening fibrillations of the heart, which could result in	-

			cardiac arrest. • It should be performed immediately after identifying that the patient is experiencing a cardiac emergency, has no pulse, and is unresponsive.	
95	DC defibrillator	-	• DC defibrillator does not produce side effects and produces normal heartbeat. • Ventricular fibrillation is avoided when high energy shock is passed through discharging capacitor that is exposed to heart or chest of the patient. • DC defibrillator consists of auto transformer that actsas primary of the high voltage transformer.	-
96	Implantable defibrillator	-	An implantable defibrillator is a device implantable inside of the body, able to perform cardioversion, defibrillation, and pacing the heart.	-
97	Defibrillator is electrodes	-	• Spoon shaped electrode (applied directly to the heart) • Paddle type electrode (applied against the chest wall) • Pad type electrode(applied directly on the chest wall)	-
98	Risk in defibrillation	-	• Skin burns from the defibrillator paddles are the most common complication of defibrillation. • Other risks include injury to the heart muscle,abnormal heart rhythms,and blood cells	-
99	Energy levels for defibrillation	-	• Monophasic-the cardiopulmonary resuscitation (CPR) algorithm recommends single shocks started at and repeated at 360 J. • Biphasic-the CPR algorithm recommends shocks initially of 150-200 J and subsequent shocks of 150-360 J.	-
100	Defibrillator analyzers	-	• Measures output energy • Measures cardioversion delay time • Measures output of pacemakers • Simulates range of ECG waveforms • Provides clinical training	-
UNIT-5 INSTRUMENTS OF SURGERY				
101	Surgical diathermy	-	Surgical diathermy is the passage of a high-frequency alternating current through the body to produce a desirable surgical	-

			effect.	
102	Principles of surgical diathermy	-	The surgical diathermy performs its function by the application of high density radio frequency current which can be used to cut or coagulate tissue.	-
103	Types of Diathermy	-	• Shortwave • Microwave • Ultrasound	-
104	Surgical diathermy machine	-	• It is the use of high frequency alternate polarity radio-wave electrical current to cut or coagulate tissue during surgery. • It allows for precise incisions to be made with limited blood loss and is now used in nearly all surgical disciplines.	-
105	Types of electro surgery techniques	-	• Cutting • Coagulation • Fulguration • Dessication • Haemostasis	-
106	Factors affecting rise in temperature	-	• Composition of the tissues • Any other heat transport system	-
107	Requirements of surgical diathermy machine	-	A high temperature arc, exceeding 1000°C at the operative site.	-
108	Safety aspects in electro surgical unit	-	Dispersive electrode cable continuity Patient circuit continuity Path current monitors.	-
109	Surgical diathermy analyzer	-	Electrosurgical unit (ESU) analyzers automate the testing and inspection of the output circuits and safety features of ESUs.	-
110	Automated drug delivery system	-	An automated drug delivery system means a mechanical system that performs operations or activities, other than compounding or administration, relative to the storage, dispensing, or distribution of drugs.	-
111	Uses of automated drug delivery system	-	It enables the introduction of a therapeutic substance in the body and improves its efficacy and safety by controlling the rate, time and place of release of drugs in the body.	-
112	Types of ADDS	-	• Automated unit dose system	-

			• Automated patient dispensing system	
113	Infusion pump	-	An infusion pump infuses fluids, medication or nutrients into a patient's circulatory system	-
114	Basic Infusion system	-	• Flow by gravity • Flow controlled by roller clamp • Difficult to set and control infusion rate	-
115	Types of infusion	-	• Continuous infusion • Intermittent infusion • Patient controlled infusion • Total parenteral Nutrition	-
116	Continuous infusion	-	It usually consists of small pulses of infusion between 500 nanolitres and 10 millilitres depending on the pump's design.	-
117	Intermittent infusion	-	It has a high infusion rate, alternating with a low programmable infusion rate to keep the cannula open	-
118	Patient controlled infusion	-	It is infusion on demand, usually with a preprogrammed ceiling to avoid intoxication	-
119	Total parenteral nutrition	-	Usually requires an infusion curve similar to normal mealtime	-
120	Uses of infusion pump	-	To provide accurate and controllable flow over a prescribed period or an demand	-
121	Drugs and therapies used	-	Chemotherapy Pain Management Total parental nutrition Anaesthesia/Sedation	-
122	Syringe pump	-	A syringe pump is a small infusion pump used to gradually administer small amounts of fluid to a patient or for use in chemical and Biomedical research.	-
123	Operations of syringe pump	-	It use a series of sensors and a motor driven plunger head to infuse liquid at a precise rate.	-
124	Implanted infusion pump	-	Implanted infusion pumps are small devices placed under your skin during surgery.	-
125	Smart pumps	-	This pumps are designed to alert the user when there is a risk of an adverse drug interaction or when the user set the pump's parameters outside of specified safety limits.	-

PLACEMENT QUESTION AND ANSWERS				
126	Biology	-	Biology is a natural science concerned with the study of life and living organisms	-
127	Mechanics	-	The branch of applied mathematics dealing with motion and forces producing motion	-
128	Biomechanics	-	The study of the mechanical laws relating to the movement or structure of living organisms	-
129	Ligaments	-	A short band of tough, flexible fibrous connective tissue which connects two bones or cartilages or holds together a joint.	-
130	Tendons	-	A tendon is a tough band of fibrous connective tissue that connects muscle to bone.	-
131	Spine	-	The spine is made up of 24 bones, called vertebrae. Ligaments and muscles connect these bones together and form what is called the spinal column.	-
132	Central Nervous System	-	Controls most functions of the body and mind.	-
133	Peripheral Nervous System	-	The primary role of the PNS is to connect the CNS to the organs, limbs, and skin.	-
134	The blood pressure within the glumerular capillaries is _____ of mercury. a) 80 mm b) 70-80 mm c) 90 mm d) 70-90 mm	-	Answer: d-70-90 mm Explanation: The renal arteries carry blood at very high pressure from the aorta into the glomerular capillary tuft. The blood pressure within the glomerular capillaries is 70–90 mm of mercury. The blood flow through the capillary tuft is controlled by the state of contraction of the muscle of the arteriole leading to the tuft.	-
135	Mix venous saturation is measured by _____ a) Ear Oximeter b) Intravascular Oximeter c) Skin Reflectance Oximeter d) Pulse Oximeter		Answer: b - Intravascular Oximeter Explanation: Mixed venous saturation varies in reflecting the changes of oxygen saturation, cardiac output, haematocrit or haemoglobin content and oxygen consumption. Intravasacular oximeters are normally used to measure mixed venous saturation, from which the status of the circulatory system can be deduced.	-
136	Bone Structure	-	The outside of the bone consists of a layer of connective tissue called the periosteum.	-
137	Composition of	-	Bone consists mainly of collagen fibers and	-

	Bones		an inorganic bone mineral in the form of small crystals. It also contains a small amount of other substances such as proteins and inorganic salts.	
138	Types of Bones	-	4 Types – Long, Short, Flat & Irregular	-
139	Electrical properties of Bones	-	Electrical potentials are generated in the bone in response to generation of stress.	-
140	Crack propagation on Bones	-	The fracture mechanics of fatigue crack propagation in compact bone. Small cracks parallel to the long axis of the bone were initiated in standardized specimens of bovine bone.	-
141	Blood Pressure	-	Blood pressure is the force that a person's blood exerts against the walls of their blood vessels	-
142	Sphygmomanometer	-	An Instrument for measuring blood pressure	-
143	Stethoscope	-	The *stethoscope* is an acoustic medical device for auscultation, or listening to the internal sounds of an animal or human body.	-
144	Laminar Flow	-	Laminar flow is a flow regime characterized by high momentum diffusion and low momentum convection	-
145	Turbulent Flow	-	In turbulent flow the speed of the fluid at a point is continuously undergoing changes in both magnitude and direction.	-
146	Arrhythmias	-	An arrhythmia is a problem with the rate or rhythm of your heartbeat.	-
147	Pacemaker	-	A pacemaker is a small device that's placed in the chest or abdomen to help control abnormal heart rhythms.	-
148	Bradycardia	-	Bradycardia is a heart rate that's too slow.	-
149	Tachycardia	-	Tachycardia is a condition that makes your heart beat more than 100 times per minute.	-
150	Fibrillation	-	Atrial fibrillation is a quivering or irregular heartbeat that can lead to blood clots, stroke, heart failure and other heart-related complications.	-
Faculty Prepared		Mrs. M. Gayathri Devi, Assistant Professor, Department of BME.	**Signature**	

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