GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Biomedical Engineering

Course / Subject Code: DI01003011

Course/Subject Name: Human Biology-I

w. e. f. Academic Year:	2024-25
Semester:	1st
Category of the Course:	PCC-01

Prerequisite:	Basic knowledge of Biology.
Rationale:	Human biology provides knowledge and underlying structural and functional concepts of the different organs and systems of the human body, from the smallest part to the whole body. Student need to become familiar with anatomical and physiological terms and their meaning, understand general anatomy and physiology of major systems and their importance in the design and use of biomedical devices. The course also provides increased awareness of personal health.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
CO-1	Use relevant anatomical terminology to identify planes, key body structures, body regions, and directions in the body.	R,U
CO-2	Distinguish between various types of cells and tissues present in each of the body systems along with their functions.	R,U
CO-3	Elaborate the structure and functions of cardiovascular system.	R,U,A
CO-4	Explain the structure and functions of the given organ of respiration system.	R,U,A
CO-5	Describe the functions of the given sensory organ and also the impact on human body of global warming and climate change.	R,U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
2	0	4	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Human Biology and Skeleto- Muscular Systems**	06	20%
	1.1 Human Biology, anatomy, and physiology 1.2 Anatomy: Anatomical planes such as median, parasagittal, coronal, axial planes, and anatomical directional terms like anterior, posterior, superior, inferior, proximal, distal, medial, lateral 1.3 Overview of the human skeleton system: bones, joints 1.4 Human muscles- skeletal, smooth, and cardiac		
2.	**Human Cell, Tissue, and Blood**	06	23%
	2.1. Cellular system: Structure and function of the cell including different organelles like cell membrane, nucleus, organelles of cytoplasm-endoplasmic reticulum, lysosomes, Golgi apparatus, mitochondria, ribosomes**,** Cell electrophysiology 2.2. Overview of Tissues: epithelial, connective tissues, muscle tissue, and nervous tissue 2.3. Blood: Composition, Properties, and functions		
3.	**Cardiovascular System**	08	23%
	3.1 Anatomy of the heart 3.2 Blood flow through the heart 3.3 Conducting System of Heart: Heart-related terms: Cardiac cycle, Heart Sounds, Heart rate, Pulse, stroke volume, Cardiac output, Blood pressure - systolic, diastolic, pulse, and mean arterial pressure, Electrocardiogram (ECG)		
4.	**Respiratory System**	04	17%
	4.1 Respiratory system: anatomy and physiology (Mechanism of respiration) 4.2 Principle of gas exchange: Internal respiration, External respiration 4.3 Air pollution's effects on the human respiration system.		
5.	**Safety and Sustainability in Industrial Instrumentation**	06	17%
	5.1 Overview of special Senses. 5.2 Anatomy and Physiology of eye 5.3 Anatomy and Physiology of ear 5.4 Impact on human body of global warming and climate change.		
	Total	**30**	**100 %**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
40 %	**49 %**	**11 %**	**--**	**--**	**--**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Ross and Wilson Anatomy and Physiology in Health and Illness Waugh, Anne; Grant, Allison Churchil Livingstone Elsevier, U.K, 2014,ISBN:978-0702032288
2. Essentials of Medical Physiology Sembulingam, K.; Sembulingam, Prema Jaypee Brothers Medical Publishers, 2019 ISBN: 978-9352706921
3. Textbook of Anatomy Singh, Vishram Elsevier,2020 2AT SIN : 0T2TB08LNNK6KH
4. Human Anatomy and Physiology made Easy Sanghani, Padma Akshat,2010
5. Essentials of Human Anatomy and Physiology Marieb, Elaine N.Pearson International New Delhi,2014, ISBN:0321919009
6. BD Chaurasia's Human Anatomy Vol 1,2 Chaurasia, B.D.CBS Publishers, 2019 2AT SIN : 02BT 07TH9BRZQ

(b) Open-source software and website:

a) www.visiblebody.com
b) https://anatomy3datlas.com
c) https://human.biodigital.com
d) https://www.cdc.gov/climateandhealth/effects/default.htm

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. hours required.
1	Identify the various anatomical planes from Human Skeleton model.	1	02*
2	Categorize various blood groups.	2	04
3	Measure blood pressure using a sphygmomanometer and stethoscope.	3	02*
4	Identify various parts of the human heart along with working of systematic and pulmonary circulation.	3	04
5	Recognize the internal structure of the human heart using the heart model.	3	04

6	Explain the blood flow through the heart using the heart-lung model.	3	04
7	Interpret electrical activity of the heart by observing ECG.	3	04
8	Calculate heart rate using an electrocardiogram.	3	04
9	Interpret various heart sounds with the use of a stethoscope.	3	04
10	Measure oxygen saturation using a pulse oximeter.	3	02*
11	Distinguish between various parts of the respiratory tract using a respiratory model system.	4	02
12	Measure lung volumes and capacities using a spirometer (spirogram).	4	02
13	Locate the various organs of the respiratory tract using the respiratory tract model.	4	02*
14	Discriminate between various layers of the skin using a skin model.	5	04
15	Identify various structures of special senses using charts/ models.	5	04
16	Locate the parts of eyes and ears using eye and ear model.	5	02
17	Identify the various types of connective tissues using a chart.	2	02
18	Identify the various types of epithelial tissues using a chart.	2	02
19	Identify bones of the skeleton using the human skeleton model.	1	02
20	Draw the biological cells by observing under a microscope.	1	02
21	Identify different joints of the skeleton using the human skeleton model.	1	02
22	Identify different muscles using the chart/model.	1	02
	Total		**60**

List of Laboratory/Learning Resources Required:

1. Model of Human skeleton
   It should have following features: life-size, plastic model, removable arms and legs, skull with movable jaw, removable head cover, bone sutures and three removable lower teeth. Display nerve branches, vertebral artery, and lumbar inter vertebral disc. It should be placed on a solid metal rack. Made with PVC, washable, unbreakable, Approx. size: 180 cm.

2. Microscope
   Observation Head: Binocular head inclined at 45-deg., rotated through 360-deg with adjustable inter-pupillary distance.
   Focusing: By Rack and Pinion mechanism with adjustable tension collar. Magnification: Standard magnification 20X & 40X with flat field.

Illumination: With an integral illuminator, 2 lamps fitted to provide both transmitted and incident illumination. Objectives: 2 sets of objectives 2X and 4X, selected by rotating nose piece through 90-degrees.Eyepieces: Standard extra wide field eyepieces WF-10X

3. Pumping Heart Model
For displaying how the heart and lungs work together for oxygen exchange with a simple hand pump to demonstrate basic heart and pulmonary blood flow, should display clearly labelled heart chambers,main artery, veins and lungs.

4. Sphygmomanometer and stethoscope
For non invasive measurement of blood pressure. Stethoscope to listen to the sounds made by the heart, lungs or intestines, as well as blood flow in arteries and veins.

5. Heart Model
It should have following features: It should show the external features and internal structures of the heart, and its relation with the large blood vessels. It should be dissectible into 3 parts. Size: 4 times enlarged of life size.

6. Model of Respiration system
It should have the following features: Human Respiratory System with Magnified Alveolus including oral and nasal cavity shown with internal details like oronasal cavity, larynx and trachea, primary bronchi and bronchial tree. Size: 150 times of life-size.

7. Model of Circulatory system
It should have following specifications: A section feature of enlarged heart and blood circulation diagram, wall of heart made of flexible material which can demonstrates the heart beating by the mechanical power, valves should show the opening and closing, Blood circulation should be shown by light flash, which in red represent arteries, in blue represent vein, should work on power supply, Size: 40x15x15 cm (Approx.), Instructional manual with description of the Blood circulation/pumping heart.

8. Model of Human heart with lungs
It should have following features: Life-size anatomical models of Larynx, Heart and Lungs, should be separated in 7 parts and have two removable lobes that shows the internal structures, the heart bisects showing atria, ventricles and valves, the larynx bisects and the diaphragm; mounted on a base and available in the size of 36x23x12 cm (Approx.)

9. Model of Skin system
It should have following features: About 100 times enlarged cross sectional view of the human skin showing three layers and a close-up view of a hair follicle, sweat gland, fatty tissue. Front,

side and back view. Mounted on a plastic base , should show the structures of the human scalp and the skin - epidermis, dermis, hypodermis as well as appendages of the skin - the sweat glands, the sebaceous glands, the hairs, Blood vessels and nerves of the skin.

10. Model of Muscle system
It should have following features: It should be full size of human body showing muscles and organs (85 cm); should consist of various parts such as muscles of chest wall and abdomen, muscles of upper and lower limbs, skull, brain and viscous. It should show the structure of head, neck, torso, upper and lower limbs, muscles, muscular tendon, ligaments, viscous, blood vessels, brain, etc.

11. Model of Eye ball dissected
It should have following features :Tunica external: It should show cornea and sclera with attachments of ocular muscles and optic nerve.Tunica media: It should show the iris, the culinary body and the choroid Tunica internal is retina.Refraction media: It should show the lens and the vitreous body. Premium graded of PVC and mounted on a plastic stand.It should be available in the size of 15 cm.(Approx.)

12. Model of Ear dissected
It should consists of parts of the ear: inner ear, auditory ossicles, external ear, Size: Four times life size

13. Pulse Oximeter
It should have following features: Integrated with SPO probe and processing display module, accurately measure and display SPO and PR, PR waveform and bar graph display, four directions and six modes, Low power consumption, shut off automatically when no signal, 1.0' double Color OLED display, resolution 128 x 64, SPO 35 ~ 99 % 2, Pulse Ratio : 30 ~ 250 BPM.

14. ECG machine
It should have following features :Light in weight, compact in size Soft, silicone-gel keyboard, Detection and alarm for lead-off and lowbattery, Automatic adjustment of baseline for optimal printing, Built-in ECG simulator for DEMO purpose, Pre 10 second printing to print out any abnormal ECG waveform, Auto-save function, printed ECG files should be saved automatically, 12-lead simultaneous acquisition, 3 Kinds of Operation Mode-AUTO, MAN and ANA, 3 Kinds of Filters- HUM, EMG and ADS, 3 Kinds of Power Supply- AC, DC, Battery, 2 Types of Lead Mode- Standard and Cabrera, 1000 ECG files should be saved to the ECG, 2000 files to SD card, should be able to communicate with PC

15. Cell Model
Should display undifferentiated cell of the animal organism at 40,000 times magnification, providing an insight into the electron-microscopic structure of the smallest microorganisms capable of independent life.

16. Tissue Charts:
Laminated with 27-micron thick polyester film rendering the chart; tear, water & dust resistant. Size : 55 x 90 cm explaining various concepts related to biology through illustrations

Suggested Project List:

The projects serve as practical learning experiences for students in the field of Instrumentation and Control Engineering. These projects integrate theoretical knowledge with hands-on application, fostering competency development across various Course Outcomes (COs). Below are guidelines for designing and executing projects:

- **Project Types:**
  - It can be industry-based, internet-based, workshop-based, laboratory-based, or field-based.
  - Each project should align with specific COs and address real-world challenges.
- **CO Integration:**
  - It should encompass two or more COs.
  - Integration involves aligning Program Outcomes (PrOs), Unit Outcomes (UOs), and Assessment and Design Outcomes (ADOs).

- **Project Duration:**
  - Students are encouraged to maintain a dated work diary to document their individual contributions and sufficient engagement time for each project should be allocated by faculty during the course.
- **Seminar Presentation:**
  - Before submission, students must give a seminar presentation on their project.
  - The presentation should highlight the project's objectives, methodology, results, and relevance to industry-oriented COs.

Following are suggestive projects, and additional ones can be tailored to specific course objectives. Encourage students to explore innovative solutions and apply their engineering skills effectively.

a) **Cell/Tissue**: Build a 3D Model. (make it from waste material).
b) **Heart :** Build a circuit/working model showing the circulation of blood.
c) **Lung :** Build a circuit working model show the gas exchange.
d) **Global warming effect on human body:** build the demonstrating model showing effect of global warming on body
e) **Anatomical plane**: Demonstrate model showing planes and anatomical terms.

Suggested Activities for Students:

In addition to classroom and laboratory learning, students are encouraged to engage in co-curricular activities that enhance their understanding and practical skills. These activities can be conducted in groups and should be documented in 5-page reports. Collecting physical evidence of their work will also contribute to their portfolio, which can be valuable during placement interviews.

a) Prepare charts of different organs of the body.
b) Undertake micro-projects in teams for making working models of different organs.
c) Seminar/Presentation on any relevant topic.
d) Categorized various diseases and disorders commonly found in various organs.
e) Identify various instruments used for measurement signals associated with different organs.

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