GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-II

Course Title: Human Biology-II
(Course Code: C4320301)

Diploma programme in which this course is offered	Semester in which offered
Biomedical Engineering	Second

1. 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. Students 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.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competencies through various teaching-learning experiences:

- **Describe the anatomical structure & principle function of major body systems such as Digestive, Excretory, Endocrine, Nervous, Reproductive etc. and creating health awareness among the society.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with the identified competency are to be developed in the student for the following Course Outcomes (COs) achievement:

a) Explain the structure & function of the Digestive System.
b) Interpret basic structure & function of Excretory System.
c) Describe various parts of the Nervous System.
d) Identify various parts associated with the Reproductive & Endocrine System.
e) Apply Fitness & Wellness concepts to Individual lifestyle.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
4	-	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be

taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** -End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the subcomponents of the Co. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Label the anatomical structure of the various organs of the digestive system using charts/models.	I	02*
2	Identify the various parts of small/Large intestine using charts/models.	I	02
3	Identify various parts of the stomach using charts/model.	I	02
4	Deduce the pathways of food in the GI tract (mouth to the anus) using digestive models.	I	02
5	Identify the organs of the excretory system using charts/models.	II	02*
6	Identify the parts of the human kidney using a kidney model.	II	02
7	Recognize the microscopic structure of the kidney using charts/models.	II	02
8	Trace the pathway of filtrate takes through the nephron using Charts/models.	II	02
9	Illustrate different phases of the Micturition cycle using charts/models.	II	02
10	Distinguish peripheral nervous system and central nervous system using charts.	III	02*
11	Identify various parts of the brain using charts/models.	III	02
12	Identify various parts of the spinal cord using charts/models	III	02
13	Identify features of nerve cells using charts.	III	02
14	Interpret electrical activity of the brain by observing EEG.	III	02
15	Identify and Locate major endocrine glands of the human body by using an endocrine system model.	IV	02*
16	Identify various hormones associated with glands using charts.	IV	02
17	Identify various organs of male reproductive system using charts.	IV	02
18	Identify various organs of the female reproductive system using charts.	IV	02
19	Classify various types of immunity.	V	02
20	Demonstrate first aid kit.	V	02*
21	Identify different exercises to increase performance of human Health.	V	02

22	Calculate Body mass index.	V	02
	Minimum 14 Practical Exercises		**28 Hrs.**

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare an experimental setup.	20
2	Operate the equipment setup or circuit/working model.	20
3	Follow safe practices.	10
4	Record observations/reading correctly.	20
5	Interpret the result and conclude.	30
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	**Digestive System Model** This model shows alimentary canal from mouth to rectum in median section and includes buccal cavity, pharynx, esophagus with half of the stomach, the opened duodenum, small and large intestine, the opened appendix, the unfolded rectum, the transverse colon, liver and pancreas.	1,2,3,4
2	**Urinary System Model** The model shows the structures of retroperitoneal cavity, pelvis with bones and muscles, inferior vena cava, aorta with its branches, upper urinary tract, kidney with adrenal gland, ureter, bladder, etc. Dissectible into 4 parts.	5
3	**Brain Model** Sensory/Motor 1/2 Brain Normal Right Half Brain features: Frontal, Parietal, Occipital and Temporal lobes; Cerebellum; Interthalamic adhesion; Corpus callosum; Pons; Midbrain-central peduncle; Olfactory bulb; Optic nerve; Optic chiasm; Mammillary body; Medulla oblongata. Model size: 15cm - 1.3cm x 13cm x 5.1cm - 1.3cm Educational Card size: 15cm - 1.3cm x 13cm - 0.6cm Suitable for neurology, general anatomical study, training for surgical dissection, sports medicine, or for patient education/demonstration of procedures.	11

4	**Human Torso Model** The model by torso, brain (2Parts), heart, esophagus trachea and aorta, lung (4 parts), skull cap, stomach, diaphragm, liver, pancreas and spleen, intestine. A total of 15 indication area	1,11
5	**Kidney Model** The coronal section of the right kidney shows the renal hilus, renal blood vessels, ureter, renal pelvis of the kidney the renal substance is demonstrated by its medulla and cortex, medullary pyramid, papillae etc. Made of PVC plastic, 2 times enlarged. Mounted on a stand.	6
6	**Male Reproductive System** Made of the Resin for long durability. Upper half part shows the median section of the system showing both internal and external organs of the system. Lower half shows the model of scrotum and contents Along with the penis.	17
9	**Female Reproductive System** Made Of Advanced Hsp Resin. Upper Half Model Shows Both Ovaries, Left Ovary In Section, Fallopian Tubes With Fimbriae, Uterus, Cut Open To Show Vaginal Folds And Cervix, Bladder With Cut Open Urethra, Labia And Rectum. In Upper Half Model. Lower Half Model Shows Adnexa Of Uterus. Size : 40x80 Cm.	18
10	**Endocrine System Model** It should have the following features: Organs of the Endocrine System showing the external structure of the following human endocrine organs: Lever, pancreas, parathyroid gland, ovary. With appropriate Life size.	15
11	**Vertebral Column Model** This model shows all significant features of each vertebra, including spinal cord, nerve roots, the vertebral artery, a herniated disc and vertebral notch etc. Special features include: flexible 29" tall vertebral column complete with pelvis, sacrum, occipital bone, vertebral artery, all nerve branches and herniated lumbar disc.	12
12	**Kidney Anatomical Chart** This chart of The Kidney shows the normal anatomy of the kidney and surrounding organs, veins and arteries. All illustrations are clearly labelled eg.sectioned left kidney, right and left kidney, adrenal gland, renal vein and artery, close-up view of pattern of parenchyma of kidney, detail of a nephron, detail of renal corpuscle, close up of fine structure of renal corpuscle, histology of juxtaglomerular apparatus.	6,7,8

13	**First Aid Kit** First Aid Kit is an all-round kit, which helps addressing your first aid needs in case of emergencies includes: Crepe Bandage (Unit-1, Size: 6 cm), Adhesive bandage (Unite-1), Adhesive bandage Round 25mm (Unite-1, Size: 25 mm), Pain Relief Gel (Unite-1), Povidone Iodine Ointment(Unite-1), Oral Clinical Thermometer (Unite-1), Antiseptic Liquid (Unite-1), Absorbent Cotton I.P. (Unite-1), Microporous Surgical tape (Unite-1), Paracip/Parachoice (Unite-1), Gauze Swab (Unite-1), Roller Gauze Unite-1, Size: 7.5 cm), A pair of Scissors (Unite-1, Size: Small), First Aid Leaflet Sticker (Unite-1)	20
14	**EEG Stimulator** It is a compact, microcontroller based instrument has five separate floating outputs and simulates Alpha-Beta Rhythm ABR, Sine, Square and Triangle waveforms with selectable frequencies and amplitudes. Demonstrates and explains the significance of specific frequency ranges (Delta, Theta, Alpha and Beta) found in all the simulated EEG waveforms.	14
15	**Digestive System Anatomical Chart** This popular chart of The Digestive System clearly illustrates the organs that make up the digestive system. All structures are labelled. The beautiful central image shows the oesophagus, liver, stomach (sectioned to show inside walls), gallbladder, pancreas, intestines, rectum, arteries and veins. Includes: illustration of the location of the digestive organs in relation to the torso, the oral cavity, wall of the stomach, wall of the jejunum, wall of the colon, arterial supply, pancreas, gallbladder and duodenum, Also includes explanatory text about the parts the various organs play in digestion.	1
16	**Human Brain Chart** Size 70x100 cm. Language English. Laminated. This chart helps us to learn about the human brain. The chart shows the detailed labelled diagrams of the brain, meninges, venous sinuses, brain stem and different parts of the brain. Printed on Strong Offset Paper, Laminated with 30 micron heat sealable Polyester Film on both the sides so that the chart never catches dirt and stays new forever. Wrinkle Free and water resistant chart to ensure that the chart lasts for long. Double side for easy installation and make it wall sticking. Everything requisite for thorough understanding of Human Physiology in its broad outline included.	10,11

17	**Stadiometer** A stadiometer is a long ruler attached to the wall. It has a sliding horizontal headpiece that's adjusted to rest on top of your head. It's a quick way of accurately measuring your height, the stadiometer measures from 4.5 in – 81 in and 11.5 cm – 205 cm with 0.125 in / 0.1 cm graduations visible on both sides of the height rod.	22
18	**Weighing Machine** Weighing Machine for Body Fitness Monitor with capacity of 120 kg and easy readable LED/LCD display.	22

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs More could be added to fulfil the development of this course competency.

a) Work as a leader/a team member.
b) Follow ethical practices.
c) Practice environmentally friendly methods and processes.

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the COs and competency. If required, more such UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at different levels)	Topics and Sub-topics
Unit-I Digestive System	1a. Draw the digestive tract and identify its associated organs. 1b. Draw structure of Oesophagus, stomach, small intestine, large intestine, liver, Pancreas Gallbladder 1c. Enlist the various functions of digestive system	1.1 Digestive system: Organs of digestive tract (GI tract) and its associated organs 1.2 Introduction of digestive tract-including basic structural and functional features of oesophagus, stomach, small intestine, large intestine, liver, pancreas, gallbladder

Unit – II Excretory System	2 a. Draw and Explain macroscopic structure of kidney. 2. b. Describe various functions of the kidney. 2.c Define terms: Ultrafiltration, Reabsorption Secretion 2. c. Explain process of urine formation 2.d. Identify Constituents of Urine 2.e .Explain micturition process.	2.1. Excretory system- structure of kidney including microscopic (nephron) and macroscopic structure- Ureter, urinary bladder, urethra. 2.2 Function of Kidney i) Urine formation 2.3 Constituents of Urine 2.4 Micturition
Unit– III Nervous System	3. a. Differentiate Central nervous system and Peripheral nervous system. 3. b. Define: Neuron Sensory ,Motor and Mixed nerves 3. c Draw basic structure of brain and identify its different parts. 3. d Draw the basic structure of the spinal cord and identify its different parts. 3. e. Draw and Explain structure of neuron. 3.f. Define properties of neuron 3. g. Define synapse and Classify the synapses. 3. h. Outline concepts of different waves (α, β, γ, θ) of EEG with its frequency and amplitude.	3.1 Introduction to nervous system- Central nervous system (CNS), Peripheral nervous system (PNS) 3.2 Nerves: Three Kinds: Sensory ,Motor and Mixed 3.3Central nervous system Brain : basic structure of brain- lobes of cerebrum, cerebellum, pons and medulla oblongata Spinal cord: basic structure of spinal cord 3.3 Neurons- Structure and Properties of neurons 3.4 Synapse- Classification of synapse 3.5Electroencephalogram (EEG)
Unit– IV Endocrine and Reproductive system	4.a Define Hormones and their properties 4.b Enlist different endocrine glands with their associated hormones. 4.c Identify location of different glands. 4.d Draw male and female reproductive system 4.e Enlist various organs associated with male and female reproductive system.	4.1 Hormones- Definition and their basic properties. 4.2 Endocrine System-location of different endocrine glands and name their associated hormones. 4.3 Male and Female Reproductive system

Unit– V Health and Wellness	5. a Enlist Environmental factors important to maintain good health and Hygiene. 5.b Define BMI 5. c Enlist different factors to maintain a healthy lifestyle. 5.d Define Immunity 5.e Explain Local defence systemand Immune system 5f Enlist various vaccines used in India to cover entire population 5. g Enlist situations where First Aid is required.	5.1 Environment- Clean Air, Clean Water, Nutrition, Sanitation 5.2 Lifestyle– Healthy lifestyle: Physical Activity, Work life balance, Body Mass Index, Stress Management 5.3 Immunity and Vaccination: Types of Immunity 5.4 First Aid

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Digestive System	12	6	8	0	14
II	Excretory System	12	8	8	0	16
III	Nervous System	12	6	10	0	16
IV	Endocrine and reproductive System	10	8	4	0	12
V	Health and Wellness	10	6	6	0	12
Total		**56**	**26**	**44**	**0**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may slightly vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their 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.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4***means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability.
g) Guide students for using instructional manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the microproject should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) **Kidney**: Build a 3D Model. (Make it from waste material).
b) **Neuron:** Build a circuit/working model showing the transmission of impulse.
c) **Digestive tract:** Build a working model showing Digestion Process.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
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 ASIN B : 08LNNK6KH
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	BD Chaurasia	CBS Publishers, 2019

14. SOFTWARE/LEARNING WEBSITES

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

15. PO-COMPETENCY-CO MAPPING

Semester I	Human Biology (Course Code: C4310301)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency	Analyse anatomical structure and physiology of the major human body systems to appreciate their importance in the design of biomedical devices.						
CO a) Explain the structure & function of the Digestive System.	3	-	1	-	-	-	1
CO b) Interpret basic structure & function of Excretory System.	3	-	1	-	-	-	1
CO c) Describe various parts of the Nervous System.	3	-	1	-	-	-	1
CO d) Identify various parts associated with the Reproductive & Endocrine System.	3	-	1	-	-	-	1
CO e) Apply Fitness & Wellness concept to Individual lifestyle.	3	-	1	-	3	-	3

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

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