w. e. f. Academic Year:	2024-25
Semester:	3
Category of the Course:	PCC

Prerequisite:	Basic science, Chemistry, Biology
Rationale:	The study of human anatomy and physiology is fundamental for biomedical engineering students to bridge the gap between engineering principles and biological systems. The rationale behind the course content is to provide students with a comprehensive understanding of the human body's structure and function, enabling them to design and innovate medical devices, diagnostic tools, and healthcare technologies.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Students will be able to demonstrate an understanding of the structural organization of the human body, including cellular and tissue architecture, and apply this knowledge to analyze physiological processes such as homeostasis, tissue repair, and cellular function.	R,U,A,A
02	Students will be able to explain the structure, functions, and accessory components of the integumentary system, and evaluate clinical conditions such as burns, infections, and skin cancer in relation to their physiological and anatomical basis.	R,U,A,A
03	Students will be able to describe the structure and classification of bones, the organization of the skeletal system, and the types of joints and their movements, while analyzing clinical conditions such as fractures, osteoporosis, and arthritis in relation to their anatomical and mechanical implications.	R,U,A,A
04	Students will be able to explain the structure and types of muscles, the mechanism of muscle contraction including the role of calcium and ATP, and analyze clinical conditions such as muscle fatigue, cramps, and muscular dystrophies in relation to their physiological basis.	R,U,A,A
05	Students will be able to analyze the anatomy and physiology of the cardiovascular and respiratory systems, including blood flow, cardiac conduction, lung mechanics, and gas exchange, and evaluate clinical disorders such as hypertension, anemia, asthma, and COPD in relation to their functional impact.	R,U,A,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA/ (I)	PBL (I)	ESE (V)	
45	0	30	45	120	04	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, TW/SL = Term-Work / Self-Learning, TH = Total Hours, ESE = End-Semester Examination, PA = Progressive Assessment

* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction to Anatomy and Physiology:** Anatomy vs. Physiology, Levels of Structural Organization - Chemical, cellular, tissue, organ, system, organismal, Anatomical Terminology - Directional terms: superior, inferior, anterior, posterior, Body planes and sections: sagittal, transverse, coronal, Body cavities: dorsal, ventral, abdominal, thoracic, Homeostasis: Definition, Mechanisms: positive and negative feedback, Examples: body temperature, blood sugar regulation.	3	7%
2.	**Cellular and Tissue Structure:** Cellular Organization: Plasma membrane: structure and function, Cytoplasm and organelles: nucleus, mitochondria, ER, Golgi apparatus, lysosomes, Cell cycle and division: mitosis and meiosis, Tissue Types : Epithelial tissue: types, location, and functions, Connective tissue: classification (bone, blood, cartilage), Muscle tissue: skeletal, smooth, cardiac, Nervous tissue: neurons and neuroglia.	6	15%
3.	**Integumentary System:** Skin, Layers: epidermis, dermis, hypodermis, Functions: protection, sensation, thermoregulation. Accessory Structures: Hair, nails, sweat glands, sebaceous glands. Clinical Aspects: Burns, skin infections, and skin cancer.	6	13%
4.	**Skeletal System:** Bone Structure, Types of bones: long, short, flat, irregular. Bone anatomy: compact vs. spongy bone. Skeletal Organization: Axial skeleton: skull, vertebral column, rib cage. Appendicular skeleton: limbs, girdles. Joints: Types: fibrous, cartilaginous, synovial. Movements: flexion, extension, rotation. Clinical Aspects: Bone fractures, osteoporosis, arthritis.	7	15%

5.	**Muscular System:** Muscle Anatomy, Structure of skeletal muscle: fibers, myofibrils, sarcomeres. Types of muscles: skeletal, smooth, cardiac. Muscle Contraction: Sliding filament theory. Role of calcium and ATP. Clinical Aspects: Muscle fatigue, cramps, and dystrophies.	7	15%
6	**Cardiovascular System:** Heart Anatomy, Chambers, valves, and blood pressure and flow. Circulation of blood – systemic and pulmonary, Cardiac Conduction System, The Cardiac Cycle, and Cardiac Output, Blood Vessels: Types: arteries, veins, and capillaries. Blood Composition: Plasma, RBCs, WBCs, platelets. Disorders: Hypertension, anemia, atherosclerosis, cardiac arrhythmias.	9	20%
7	**Respiratory System:** Structure: Lungs, trachea, bronchi, alveoli, Physiology: Lung Volumes and Capacities, Mechanism of breathing: inspiration, expiration, Gas exchange and transport. Clinical Aspects: Asthma, pneumonia, COPD.	7	15%
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**20**	**10**	**10**	**10**	**10**

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. Guyton and Hall Textbook of Medical Physiology, John E. Hall PhD, and Saunders; 13th Edition, ISBN-10: 1455770051.
2. Principles of anatomy and physiology, Gerard j. Tortora, Bryan derrickson, 13th Edition, john Wiley & sons, Inc.
3. Human Anatomy & Physiology, Global Edition, 12th edition, Elaine N. Marieb Holyoke Community College Katja Hoehn Mount Royal University, Pearson.
4. Review of Medical Physiology, 22nd Edition (A Lange Medical book series) McGraw –Hill (International Ed.) 2003.
5. Waugh, Anne and Allison Grant "Ross and Wilson Anatomy and Physiology in Health and Illness", 12thEdition, Churchill –Livingstone / Elsevier), 2014.
6. Essentials of medical physiology, Sembulingam, Jaypee brothers medical publishers; seventh edition (2016), isbn-10: 9789385999116

(b) Open source software and website:

1. Khan academy

2. Coursera
3. MIT open courseware
4. OpenStax
5. Human BioDigital
6. National Center for Biotechnology Information (NCBI)

Suggested Course Practical List:

1. To study different body positions, anatomical planes and sections.
2. To study cell structure & different organelles.
3. To study integumentary system.
4. To study structure and function of bone.
5. To study various body joints.
6. To study anatomy of cardiovascular system.
7. To perform test for blood grouping.
8. To measure blood pressure using sphygmomanometer.
9. To study respiratory system.

List of Laboratory/Learning Resources Required: Blood group testing kit, Sphygmomanometer, Stethoscope, Stained tissue specimens, Compound Microscope, Digital microscope.

Suggested Project List:

1. Make anatomical models for various systems listed in the syllabus.
2. Make charts/illustrations on a drawing sheet to understand and visualize anatomical and physiological aspects of the body systems.
3. Make charts/illustrations on diseases/ disorders associated to the body systems listed in the syllabus.

Suggested Activities for Students:

1. Make computerized presentation on various topics listed in the syllabus and related to the syllabus. (Student wise (Individual) activity).
2. Arrange the question answer session for each students to participate in the presentation.

- **List of suggested activities for Problem Based Learning:**

Sr. No.	Name of the activity	No. of hours per activity	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numerical based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based assignment of 2h each. Total = 10h	Based on the coding solution submitted.
5.	Self-learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment/health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.

13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.
14.	Application/Software development	Duration = 10 h	Depending on the complexity of the Application/Software
15	Online Technical Quizzes/Simulations	Multiple quizzes summing up to 10h	Based on quiz scores and reflection report after each quiz.
16	Patent Search and Innovation Gap Identification	10h (Search + Report)	Based on number of relevant patents analyzed and identification of innovation scope.

Note:

1. All the suggested activity should be related to the subject.
2. Subject coordinator shall identify activities from above list as per the subject needs, they also declare list of activities wise hours, evaluation scheme and rubrics to students at the start of semester.
3. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
4. All records pertaining to the evaluation and assessment of self-learning activities must be properly maintained and preserved at the institute level. These records should be made available to the university upon request.
5. Institutes are encouraged to utilize digital platforms, such as Microsoft Teams, for effective record-keeping and to ensure transparency in the evaluation and assessment of self-learning activities.

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