TAMIL NADU PHYSICAL EDUCATION AND SPORTS UNIVERSITY

CHENNAI- 600 127

CURRICULUM

B.Sc., SPORTS BIOMECHANICS AND KINESIOLOGY

(REGULAR 2023-2024)

DESCRIPTION OF THE DEPARTMENT

The Department of Sports Biomechanics and Kinesiology has been offering the following programme:

1. BSc., Sports Biomechanics and Kinesiology (Regular Three Years Programme) since 2019-2020 academic year.
2. MSc., Sports Biomechanics and Kinesiology (Regular Two Years Programme) since 2008-2009 academic year.
3. PhD Sports Biomechanics and Kinesiology (Regular Three Years / Part time -4 years Programme) since 2015.

VISION OF THE DEPARTMENT

The Department of Sports Biomechanics and Kinesiology aims to produce skilled sports biomechanics and kinesiology professionals with holistic approach to promote and serve in the domains of sports performance analysis, human gait and posture, fitness and exercise prescription, strength and conditioning, sports science, biomechanics and kinesiology R&D, equipment design and development, ergonomics, rehabilitation, prehabilitation, clinical biomechanics, academics, research and consultancy services in biomechanics.

OBJECTIVES OF BSc SPORTS BIOMECHANICS AND KINESIOLOGY UNDER GRADUATE PROGRAMME:

1. To gain knowledge on anatomy and physiology, kinesiology, biomechanics, motor skills, techniques of human movement and sports skills, research and statistics, and biomechanical instrumentation and measurement in 2D and 3D with inverse dynamics, EMG, force plate, Isokinetic Dynamometry etc.,
2. To apply the principles of mechanics on the human movement and sports skills to enhance the performance and reduce the risk of injury.
3. To analysis the sports skill technique/performance qualitatively and quantitatively using the biomechanical instrumentation and measurement.
4. To gain knowledge in the area of gait analysis and analysis the normal gait and pathological gait.
5. To assess the human body posture and prescribe corrective exercise to correct postural deviations.

6. To create a platform for students to engage in sports biomechanics research and pursue higher research degrees.
7. To produce an efficient sports biomechanist to work in research laboratories, sports academies, national teams, and faculty in academic institutions.
8. To produce sports performance analyst to work with sports teams/sports clubs/research labs as sports performance analyst.

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REGULATIONS

The Choice Based Credit System (CBCS) and Learning Based Outcome Curriculum Framework (LBOCF) for three years B.Sc. Degree programme in Sports Biomechanics and Kinesiology will be implemented from the academic year 2023-2024.

1. ELIGIBITLITY FOR ADMISSION

1.1 A candidate shall be admitted to the degree B.Sc. in Sports Biomechanics and Kinesiology Only if he/she produces satisfactory evidence to the effect that he/she has successfully completed Plus Two (XII Std in any science group / +2 with Maths / Statistics / Computer application / Physical Education), under SB/CBSE/CSE recognized by the syndicate of TNPESU.

1.2 Eligible for admissions and reservation of seats shall be according to the rules framed by the governing body of this University in this regard, from time to time at par with the UGC norms and regulations of the Government of Tamil Nadu. The total Number of Seats for UG is 30.

2. COURSE OF STUDY

2.1 The normal duration of the B.Sc., Sports Biomechanics and Kinesiology Programme shall be **SIX** semesters **(THREE years).** The maximum duration of the course is **6 years** from the date of joining.

2.2 There shall be **two semesters in an academic year**, the **ODD and EVEN** semesters. **Odd semesters** shall be from **July to November** and **Even Semesters** shall be from **December to May**.

2.3 Each semester will have a **minimum of 90 working days** and **each day will have six working hours.** Teaching is organized into a modular pattern of

credit courses. Credit is normally related to the number of hours a teacher teaches a particular subject.

3. CHOICE BASED CREDIT SYSTEM (CBCS) and LEARNING BASED OUTCOME CURRICULUM FRAMEWORK (LBOCF)

The Tamil Nadu Physical Education and Sports University follows the **Choice Based Credit System (CBCS) and Learning Based Outcome Curriculum Framework (LBOCF).** One credit is equal to one teaching hour per week during the semester. The CBCS in B.Sc., Sports Biomechanics and Kinesiology Degree Programme would have five components and the total credit requirements for all components in three years is 145 credits.

3.1 **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching or two hours of practical work.

3.2 **Core course:** Are course that are basic to the subject of the degree. This is a course which is to be compulsorily studied by a student as a core requirement to the completion of the program.

3.3 **Elective Courses:** This is a course that is supportive to the discipline of study, provides an expanded scope, enables exposure to some other domains or nurtures proficiency/skills.

3.3.1 **Discipline Specific Elective (DSE):** These courses are inter disciplinary in nature and considered similar to core course. And, the students have to choose one course from the option provided for them.

3.4 **Skill Enhancement Courses (SEC)** (minimum 4 for regular courses): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge and should contain both theory and lab/hands-on/training/field work. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability.

3.5 **Ability Enhancement Courses (AEC):** The Ability Enhancement (AE) Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). “AEC” courses are the courses based upon the content that leads to Knowledge enhancement; i. Environmental Science and ii.

English/Hindi/MIL Communication. These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

3.6 **Ability Enhancement Compulsory Courses (AECC):** Environmental Science, English Communication/Hindi Communication/ Modern Indian Languages (MIL) Communication.

The following are the components:

Course Components	Types of Courses	No. of Courses	Credits	Total Credits
Part – I	Language / Special English	4	3	12
Part – II	English	4	3	12
Part – III	Core Courses	15	4	60
	Core Elective Courses	5	3	15
	Core Practicum	11	2	22
	Internship	1	2	2
	Group project	1	4	4
Part – IV	Skill Enhancement Courses	4	2	8
	Ability Enhancement Courses	2	2	4
Part – V	Environmental Studies	1	2	2
	Value Education	1	2	2
	Extension Activity (Swachh Bharath)	1	2	2
Total Credits				**145**

CGPA- CUMULATIVE GRADE POINT AVERAGE: A CGPA credit course has been classified into the **Three Components (Part I to Part III).** The marks earned in the CGPA courses will be calculated for overall percentage of marks.

NON- CGPA: The students can earn additional credits by the way of choosing Non-CGPA compulsory credit course such as ability enhancement courses, skill

enhancement courses and Extension activities **(Part -IV and V).** The marks scored in the NON-CGPA courses will not be accounted in overall percentage calculation.

4. COURSE WEIGHT

4.1 Courses have been designed with weightage of **two / three / four credits**, depending upon the content, duration and specialization. All courses need not carry the same weight. A course may comprise **lectures / tutorials / laboratory/ field work / outreach activities / project work / vocational training / viva / seminars etc. or a combination of some of these.**

4.2 It determines the number of hours of instructions required per week.
Theory: Each theory hour per week is considered as **1 credit.**
Practical: Each two practical hours per week is considered as **1 credit.**

5. CREDIT DISTRIBUTION

The Credit distribution for the six semesters are given below:

SEMESTER	CREDITS	TOTAL MARKS
I	23	**900**
II	23	**800**
III	23	**800**
IV	25	**900**
V	26	**900**
VI	25	**900**
	145	**5200**

6. ASSESSMENT AND EVALUATION

6.1 Each course will be assessed on the basis of 100 marks. The marks would be divided between internal and external assessment.

6.2 There shall be one end semester external examination for each course in every semester consisting of 75% (75 marks) weight in theory and 75% (75 marks) in practical courses.

6.3 Each Theory course shall have internal assessment of 25% weightage on the following:

Components of Internal Evaluation of Theory	Marks
Assignments /Seminars /quiz etc	**5**
Test Paper – I & Test Paper - II	**10**
Model Examination	**10**
Total	**25**

6.4 Each Practical Course shall have internal assessment of 25% weightage on the following:

Components of Internal Evaluation of Practicum	Marks
Internal Viva	**10**
Lab Record	**5**
Lab Performance	**10**
Total	**25**

6.5 The minimum passing standard will be 40% for the external and internal component of each theory course, i.e. 30 marks out of 75 (external - 40% of 75 marks) and 10 marks out of 25 (internal - 40% of 25 marks). In practical minimum passing standard will be 40% for the external exam and internal assessment for each practical course (30/10).

7. ATTENDANCE

7.1 Every teaching faculty handling a course shall be responsible for the maintenance of attendance register for candidates who have registered for the course.

7.2 Students must have 75% of attendance in each course for appearing in the examination.

7.3 Students who have 74% to 70% of attendance shall apply for condonation in the prescribed form with the prescribed fee.

7.4 Students who have 69% to 65% of attendance shall apply for condonation in prescribed form with the prescribed fee along with the Medical Certificate.

7.5 Students who have below 64% to 60% of attendance are not eligible to appear for the examination. It is furthered clarified that the students, Carry over to the next semester.

7.6 Students who have below 60% of attendance are not eligible to appear for the examination. It is furthered clarified that the students, Re do the course.

7.7 A student cannot claim condonation as his/her right and the condonation is at the discretion of the Head of the Department. A student can avail condonation / carry over only once during his course of study.

8. END SEMESTER EXAMINATION (ESE)

8.1 The ESE will consist of à written examination of three hours duration for a maximum score of 75. The following procedure will be followed for evaluation.

8.2 A candidate who has secured a minimum of 40 marks in all courses prescribed in the programme and earned a minimum of the credits will be considered to have passed the Bachelor's Degree Programme.

Pattern	Total No. of Question	Number of Question to be Answered	Marks for each Question	Total Marks
MCQ	10	10	1	**10**
Short Answer	5	5	2	**10**
Short Essay / Problem Type	8	5	5	**25**
Essay / Problem Type	5	3	10	**30**
Total				**75**

8.3 Distribution of 25 Marks for Semester End Practical Examination weightage on the following:

Components of External Evaluation of practicum	Marks
Lab Experiment / Field Experiment	10
Lab Performance / Demonstration	5
Viva-voce	5
Lab Record	5
.Total	25

8.4 A Student will be issued, hall ticket only if one produces "**No Dues**" certificates from the concerned department, the laboratory, the Registrar's Office, the Library and Hostel.

9. GRADING SYSTEM

A ten-point rating is used for the evaluation of the performance of the student to provide a letter grade for each course and overall grade for the Under Graduate Programme. The letter grade assigned is given below:

Letter	Grade	Grade Point	Range of Marks
O	Outstanding	10	90-100
A+	Excellent	9.0	80-89
A	Very Good	8.0	70-79
B+	Good	8.0	60-69
B	Above Average	7.0	50-59
RA	Reappear	6.0	Below 50
AB	Absent	N.A	ABSENT

9. INTERNSHIP AND FIELD TRAINING

Internship and field training is an important component of Sports biomechanics and Kinesiology that provides students with the opportunity to gain applied practical experience in the field of Sports biomechanics and Kinesiology. It allows a student to employ what is learned in class in a supervised environment, which is critical in order to further develop professional skills and assure quality practice. The students will undergo Internship training /Field training/ Clinical practice in TNPESU campus/ Sports

Development Authority of Tamil Nadu (SDAT) coaching Centres / Sports Authority of India (Various coaching Centres of SAI) / Government Medical College/ other sporting centers shall be evaluated through internal assessment only. At the end of Internship/field training, the student shall submit a certificate from the organization where he /she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally.

PROGRAMME OUTCOMES (POs):

After successful completion of three-year degree program in Sports Biomechanics and Kinesiology should be able to:

PO1	Demonstrate and an understanding of major concepts in all disciplines of Sports biomechanics and Kinesiology
PO2	Solve the problem and also think methodically, independently and draw a logical conclusion. Employ critical thinking and the scientific knowledge to design, carry out, record, demonstrate, plan, and analyze.
PO3	The graduates will display professional and ethical behavior. The graduates will be able to communicate professionally.
PO4	Create an awareness of the impact of Sports biomechanics and Kinesiology on the environment, society, and development outside the scientific community.
PO5	After completion of graduation, they would be able to apply the acquired concepts and principles to study different branches of Sports biomechanics and Kinesiology in their future career. When a student pursues for postgraduate studies, he or she can make use of all the applications, field or laboratory which he or she has gained knowledge. This B.Sc. Programme will also help students to enhance their employability for jobs in different sectors.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1	Identify and list out common structure and functions of various systems of human body and movement patterns.
PSO2	Understanding and analysis of the human movement (Kinesiology) in Qualitative and quantitative method
PSO3	Understanding the basic concepts of biomechanics, mathematics in biomechanics and computer applications
PSO4	Identification of key performance indicators in each sport and sports performance analysis
PSO5	Understanding Sports talent identification, kinathropometry, posture and gait
PSO6	Understanding technique of various sports and games and analyzing kinematics and kinetics of human movement through 3D motion capture, EMG, Force plate, IKD
PSO7	Understanding Sports talent Identification and Sports performance analysis and reporting
PSO8	Learn to use the advanced tools in biomechanics and identification of strength and weakness of athlete and prescription of remedial measures.
PS09	Gaining hands on experience in collecting valid data and writing scientific research papers
PS10	Design a sports specific biomechanical assessment for performance enhancement and recovery from injury

SEMESTER- I

Parts	Course Code	Course	Hours / Week)		Marks		
			L/T/P	C	CIA	ESE	Total
Part-I	23UF1LT101	Tamil I / Special English I	3	3	25	75	100
Part-II	23UF1LE102	English I	3	3	25	75	100
Part-III	23UF1CT103	Human anatomy and Physiology - I	4	4	25	75	100
	23UF1CT104	Fundamentals of fitness and exercise prescription	4	4	25	75	100
	23UF1CE105	Test, measurement and evaluation	3	3	25	75	100
	23UF1SE101	Human anatomy and Physiology - Practicum	4	2	25	75	100
	23UF1SE102	Test, measurement and evaluation - Practicum	4	2	25	75	100
Part-IV	23UF1AE101	Soft Skills Development (AEC)	2	2	50	50	100
			27	**23**	**225**	**575**	**800**
Remark: Soft skill I - 2 hours handled by English: Totally 3+2=5							

SEMESTER- II

Parts	Course Code	Course	Hours / Week)		Marks		
			L/T/P	C	CIA	ESE	Total
Part-I	23UF1LT201	Tamil II / Special English II	3	3	25	75	100
Part-II	23UF1LE202	English II	3	3	25	75	100
Part-III	23UF1CT203	Human Anatomy and Physiology – II	4	4	25	75	100
	23UF1CT204	Physics for Biomechanics	4	4	25	75	100
	23UF1CE205	Mathematics for Biomechanics	3	3	25	75	100
	23UF1SE201	Human Anatomy and Physiology - Practicum-II	4	2	25	75	100
	23UF1SE202	Physics for Biomechanics Practicum	4	2	25	75	100
Part-IV	Naan Mudhalvan (SEC)	Communication skills	2	2	50	50	100
			27	**23**	**225**	**575**	**800**

Note:

1. *Naan Muthalvan - Skill course - external 50 marks will be assessed by industry and internal will be conducted by the respective course teacher.

SEMESTER- III

Parts	Course Code	Course	Hours / Week)		Marks		
			L/T/P	C	CIA	ESE	Total
Part-I	23UF1LT301	Tamil III / Special English III	3	3	25	75	100
Part-II	23UF1LE302	English III	3	3	25	75	100
Part-III	23UF1CT303	Kinesiology	4	4	25	75	100
	23UF1CT304	Basic Biomechanics	4	4	25	75	100
	23UF1CE305	Dynamics of Motor Skill Acquisition	3	3	25	75	100
	23UF1SE301	Kinesiology Practicum	4	2	25	75	100
	23UF1SE301	Basic Biomechanics Practicum	4	2	25	75	100
Part-IV	23UF1AE101	Soft Skills Development – II (AEC)	2	2	25	75	100
			28	**23**	**200**	**600**	**800**
Remark :Soft skill I - 2 hours handled by English: Totally 3+2=5							

SEMESTER- IV

Parts	Course Code	Course	Hours / Week)		Marks		
			L/T/P	C	CIA	ESE	Total
Part-I	23UF1LT401	Tamil IV / Special English IV	3	3	25	75	100
Part-II	23UF1LE402	English IV	3	3	25	75	100
Part-III	23UF1CT403	Human gait, posture and corrective exercise	4	4	25	75	100
	23UF1CT404	Physiology of exercise and ergogenic aids	4	4	25	75	100
	23UF1CE404	Science of Sports Training and Strength and conditioning	3	3	25	75	100
	23UF1SE401	Human gait, posture and corrective exercise Practicum - I	4	2	25	75	100
	23UF1SE404	Physiology of exercise Practicum - II	4	2	25	75	100
Part-IV	Naan Mudhalvan	Python Programming (IITM & GUVI) MOOC (SEC)	2	2	50	50	100
Part-V	23UF1ES301	Environmental studies	2	2	25	75	100
			30	**25**	**250**	**650**	**900**

Note:

1. *Naan Muthalvan - Skill course - external 50 marks will be assessed by industry and internal will be conducted by the respective course teacher.
2. A minimum of four weeks Internship will be carried out during the summer vacation after the **second year.** Viva Voce will be conducted by the internal examiners of the Department and marks shall be sent to the COE of University for its inclusion in the **Fifth Semester Marks Statement.**

SEMESTER- V

Parts	Course Code	Course	Hours / Week)		Marks		
			L/TP	C	CIA	ESE	Total
Part-III	23UF1CT501	Applied Biomechanics	4	4	25	75	100
	23UF1T502	Research Methodology and Statistics in Sports Science	4	4	25	75	100
	23UF1CT503	Biomechanics of track events	4	4	25	75	100
	23UF1CT504	Biomechanics of field events	4	4	25	75	100
	23UF1SE501	Applied biomechanics Practicum	4	2	25	75	100
	23UF1SE502	Biomechanics of track and field events Practicum	4	2	25	75	100
	23UF1CI501	Internship	4	2	100	-	100
Part-IV	23UF1SEC501	SPSS (SEC)	2	2	50	50	100
Part-V	23UF1VE501	Value Education	2	2	25	75	100
			32	**26**	**325**	**575**	**900**

SEMESTER- VI

Parts	Course Code	Course	Hours / Week)		Marks		
			L/TP	C	CIA	ESE	Total
Part-III	23UF1CT601	Sports performance analysis	4	4	25	75	100
	23UF1CT602	Biomechanics of sports and games - I	4	4	25	75	100
	23UF1CT603	Biomechanics of sports and games - II	4	4	25	75	100
	23UF1CE601	Biomechanics of yoga	3	3	25	75	100
	23UF1SE601	Group project	4	4	25	75	100
	23UF1SE602	Open Sim / Visual3D - practicum	4	2	25	75	100
Part-IV	23UF1SEC601	MATLAB (SEC)	4	2	50	50	100
Part-V	23UF1EA601	Swachh Bharath	-	2	-	-	-
			27	**25**	**200**	**500**	**700**

***L (Lecture), T (Tutorial), P (Practical), C (Credits), CIA (Continuous Internal Assessment), ESE (End Semester Exam)**

CONTENTS OF COURSE
SEMESTER - I

COURSE CODE: 23UD1CT101

HUMAN ANATOMY AND PHYSIOLOGY-I

Learning Objectives

1. To impart knowledge on structure and functions of different organs
2. Learn the integrated functioning of cells, tissues, organs and systems
3. To introduce the interrelationship between nutritional science and physiological functions

UNIT-I Cell Biology: Introduction to human anatomy, Anatomical terms, language of anatomy, levels of organization, various organ systems. Cell: Definition, structure and function. Cell division: Mitosis and Meiosis. Tissues: Definition, classification and function- Epithelial tissue, Connective tissue, Muscle tissue and Nervous tissue-Body Membranes.

UNIT-II- Blood: Definition and Functions- Composition of blood – Types and Functions of blood cell –Red Blood Cells (RBC) -Hemoglobin, White Blood Cells (WBC)- Types of White Blood Cells – platelets and Plasma. Blood Grouping and Typing. Blood Clotting - Definition and Mechanism.

UNIT-III –Bones: Histology and Physiology of Bones -A brief introduction to bones, joints, ligaments and muscles of the body-Structure and Functions of Skeletal System. Anatomical terms of bones - axial skeleton, appendicular skeleton. Bones of the upper limb, Bones of the lower limb, the vertebral column, the sternum, ribs and the skull. Types of Bones- Sex Differences in the Skeleton.

UNIT-IV Cardiovascular System: Position, Structure and Function of the heart. – Types of Blood Vessels: Arteries, Capillaries and Veins. Cardiac Cycle and Heart Sounds. Blood Flow - Arterial Pulse and Blood pressure – Definition, Procedure to measure and its values. Types of circulation: Systemic, Pulmonary, Coronary and Portal circulation. Lymphatic system- structure and function.

UNIT-V Respiratory system: Structure and Functions of Upper and Lower Respiratory System. Mechanism of breath inspiration and Expiration. Mechanism and Control of respiration., Gaseous exchange in lungs and tissues, Transport of oxygen and carbon dioxide.

Reference Books:

1. Jason LaPres, Beth Kersten and Yong Tang, (2016), Gunstream's Anatomy & Physiology: With Integrated Study Guide, Sixth Edition, McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121.
2. Cinnamon L. Van Putte, Jennifer L. Regan & Andrew F. Russo, (2017), Seeley's Anatomy & Physiology, Eleventh Edition, McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121.
3. Clancy, John & Andrew J.McVicar (1995), "Physiology & Anatomy – A Homeostatic Approach", London: Edward Arnold, A Division of holder head line PLC.
4. Guyton, A.C. (1979) Physiology of the Human Body. 5th ed. Saunders College of Publishing, Philadelphia.

E-Learning resources:

1. https://www.youtube.com/watch?v=jFKCXLiNxA&list=PLyj7LvLOVR9pnvfF2TmRLXZ5NkyzlE8tI&index=11
2. https://www.youtube.com/watch?v=9KOZ2pr7yTE&list=PLyj7LvLOVR9pnvfF2TmRLXZ5NkyzlE8tI&index=3
3. https://www.youtube.com/watch?v=EFGvb6_tuoA&list=PLyj7LvLOVR9pnvfF2TmRLXZ5NkyzlE8tI&index=5
4. https://www.youtube.com/watch?v=hXNtcxfdd3E&list=PLyj7LvLOVR9pnvfF2TmRLXZ5NkyzlE8tI&index=17
5. https://www.youtube.com/watch?v=R_8lx3Nt0OM&list=PLyj7LvLOVR9pnvfF2TmRLXZ5NkyzlE8tI&index=16
6. https://www.youtube.com/watch?v=OsrrNDid7XU&list=PLyj7LvLOVR9pnvfF2TmRLXZ5NkyzlE8tI&index=19

Course Outcomes

CO No	Course outcomes
CO 1	Identify the major levels of organization, major components of each organ and define the relationship between anatomy and physiology
CO 2	Describe the composition of different blood groups and their role in the body.
CO 3	Identify the classification of bones and joint movements
CO 4	Identify the structure and label the parts of respiratory system. Lung volumes and Capacities
CO 5	Illustrate the Structure and Function of the heart.

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

S-Strong 3; M-Medium 2; L-Low 1

COURSE CODE: 23UDICT102

FUNDAMENTALS OF FITNESS AND EXERCISE PRESCRIPTION

Learning Objectives

1. To understand the importance of physical activity and health
2. To acquire skills to asses the cardiorespiratory fitness, muscle strength, body composition and flexibility components.
3. To design the exercise program for normal and special population

Unit – I

Physical activity and health – Health Benefits of physical activity - Domains of Physical Activity. Physical Activity Recommendations - Prevalence of Physical Activity - Benefits of Physical Activity and Chronic Disease. Benefits of Physical Activity and Chronic Disease - The Health Consequences of Physical Inactivity and Sedentary Behavior - Physical Inactivity- Sedentary Behavior - Preparticipation Screening, Fitness Assessment, and Interpretation - Preparticipation Health Screening - Risk Stratification for Those in Cardiac Rehabilitation and/or Medical Fitness Facilities.

Unit -II

Cardiorespiratory Fitness Assessment-Measuring Cardiorespiratory Fitness and the Maximal Oxygen Uptake-Contraindications to Exercise Testing - Maximal versus Submaximal Exercise Testing - Guidelines for Exercise Testing - Cardiorespiratory Test Sequence and Measurements - Procedures and Protocols for Maximal, Submaximal, and Field Exercise Tests - Field Tests for Cardiorespiratory Fitness Tests - Criterion-Referenced Standards versus Normative Data.

Unit – III

Muscle Strength Assessment - Dynamic Strength (Isotonic) - Muscular Endurance Strength - Isometric (Static) Strength–Handgrip Strength - Rate of Force Development - Isokinetic Strength Assessment - Functional Strength Assessments - Functional Movement Screen - Strength Evaluation.

Body Composition Assessment - Rationale for Body Composition Assessment - Body Composition Models - Methodologies in Body Composition Assessment - Body Composition Assessment in Children and Adolescents - Body Fat Prediction Equation Selection - Interpretation of Body Fat Percentage Estimates.

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Unit-IV

Flexibility and Functional Movement Assessments - Functional Movement Assessments - General Principles of Exercise Prescription - Exercise Prescription for All - Current FITT-Recommendations from the American College of Sports Medicine - Aerobic Frequency - Aerobic Intensity- Aerobic Time (Duration) - Aerobic Type (Mode) - Aerobic Volume - Aerobic Progression - Resistance Components - Flexibility Components - Neuromotor Components - Setting Up a Program - **Special Considerations across the Lifespan: Pregnancy, Children - and Youth, and Older Adults** – **Pregnancy** - Preparticipation Health Screening, Medical History, and Physical Examination Exercise Testing Considerations Exercise Prescription and Progression Considerations - **Children and Youth** - Exercise Testing Considerations - Exercise Prescription and Progression Considerations Special Considerations and Physical Activity Recommendations for - Children and Youth - **Older Adults -** Exercise Prescription and Progression Considerations - Special Considerations for Exercise and Older Adults

Unit-V

Exercise Testing and Prescription for Special Populations - Testing and Prescription for Special Populations Special Considerations for Cardiovascular Disease: Chronic Stable - Angina and Coronary Artery Bypass Graft Surgery - Graded Exercise Testing Considerations: Pretransplant - Graded Exercise Testing Considerations: Posttransplant - Special Considerations for Type 1 and Type 2 Diabetes Mellitus - Special Considerations for Metabolic Syndrome, Hypertension, and Dyslipidemia - Special Considerations for Chronic Obstructive Pulmonary
Disease - Special Considerations for Asthma and Interstitial Lung Disease - Special Considerations for Weight Management - Special Considerations for Chronic Pain - Special Considerations for Cancer - Special Considerations for Bone Health and Osteoporosis - Special Considerations for Psychological Health - Special Considerations for Physical and Intellectual
Disabilities.

Reference Books:

1. **ACSM's Health/Fitness Facility Standards and Guidelines**, New York: Human, Kinetics, 1992.
2. **ACSM's Health related Physical Fitness Assessment manual**, Lippin Cott, 2008.
3. Michael Boyle. **Functional Training for Sports.** Human Kinetics, 2004.

4. Clake, H. Harrison. **Application of Measurement to Health and Physical Education, New Jersey:** Prentice Hall Inc. 1976.
5. Jensen, Clayne, R & Cyntha C. Hirst. **Measurement in Physical Education and Athletics,** MacMillan Publishing co., Inc New York, 1982
6. Juan Carlos. **Functional Training. Human Kinetics**. 2016
7. Arnold G. Nelson & Jouko Kokkonen, **Stretching anatomy**. Human Kinetics. 2007.
8. Edmund O. Acevedo and Michael A. Starks. **Exercise Testing and Prescription lab Manual,** USA: Human Kinetics Publishers, 2003.
9. Claudio Gil Soares de Araujo. **Flexi test,** USA: Human Kinetics Publishers, 2004.
10. Thomas and Roger. **Essentials of strength training and conditioning,** 3rd edition, Human Kinetics, 2008.
11. Vern Gambatta. **Athletic Development**. Human Kinetics, 2007.
12. Ryan George. **Free weight training anatomy.** Ulysses Press. 2016.

Course Outcomes

CO No	Course outcomes
CO 1	Learn the importance physical activity, health screening, fitness and components of Fitness
CO 2	Understand the different tests to measure cardiovascular fitness components
CO 3	Acquire the skills to measure muscle strength and body composition
CO 4	Acquire the skills to measure Flexibility and Functional Movement Assessments
CO 5	Design the exercise program for normal and special population

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

S-Strong 3; M-Medium 2; L-Low 1

COURSE CODE: 23UD1CE101
TEST, MEASUREMENT AND EVALUATION

Learning Objectives

1. To understand the importance of test, measurement and evaluation in sports
2. To acquire skills to construct norms, assess health and skill related fitness tests.
3. To learn and acquire the skills to conduct sports specific skill tests

Unit I

Test, measurement and evaluation: Definition and meaning of test, measurement and evaluation in Sports - Need and importance of test, measurement and evaluation in Sports science - Interrelationship between test, measurement and evaluation - Different types of testing procedure in sports - Factors affecting test, measurement and evaluation - Criteria for Test Selection– Scientific Authenticity - Meaning, definition and establishing Validity, Reliability, Objectivity, Norms– Administrative Considerations - Construction of physical fitness test, knowledge test, skill tests.

Unit-II

Motor Fitness Meaning and Definition of Motor Fitness- Test for Motor Fitness; Oregon Motor Fitness Test (Separately for boys and girls) – Motor Ability; Barrow Motor Ability Test– Newton Motor Ability Test–Muscular Fitness–Kraus Weber Minimum Muscular Fitness Test - Physical Fitness Tests **-** AAHPERD Health Related Fitness Battery (revised in 1984) - ACSM Health

Related Physical Fitness Test, Roger's Physical Fitness Index. Motor Educability Tests: Metheny-Johnson motor educability test.

Unit-III

Anthropometry and Physiological testing: Anthropometric Measurements: Method of Measuring Height: Standing Height, Sitting Height. Method of measuring Circumference: Arm, Waist, Hip, Thigh. Method of Measuring Skin folds: Triceps, Sub scapular, Suprailiac. **Physiological Testing**: Treadmill test -cycle tests – Tests of Anaerobic Capacity and Anaerobic power – Lactic acid test – Hydration measurement.

Unit-IV

Fitness tests; Cardiorespiratory endurance test: distance test, step test and time test - speed tests - explosive power- agility - reaction time - static and dynamic balance tests – Coordination – strength and strength endurance – flexibility test – Questionnaires.

Unit-V

Specific Sports Skill Test: **Badminton**: Miller Wall Volley Test. **Basketball:** Johnson Basketball Test, Harrison Basketball Ability Test. **Cricket**: Sutcliff Cricket test. **Hockey:** Friedel Field Hockey Test, Harban's Hockey Test, **Volleyball:** Russel Lange Volleyball Test, Brady Volleyball Test. **Football**: Johnson Soccer Test, Mc-Donald Volley Soccer Test. **Tennis**: Dyer Tennis Test.

Handball: Cornish Handball Test.

Reference:

1. **ACSM's Health/Fitness Facility Standards and Guidelines**, New York: Human, Kinetics, 1992.
2. **ACSM's Health related Physical Fitness Assessment manual**, Lippin Cott, 2008.
3. Michael Boyle. **Functional Training for Sports.** Human Kinetics, 2004.
4. Clake, H. Harrison. **Application of Measurement to Health and Physical Education, New Jersey:** Prentice Hall Inc. 1976.
5. Jensen, Clayne, R & Cyntha C. Hirst. **Measurement in Physical Education and Athletics,** MacMillan Publishing co., Inc New York, 1982
6. Juan Carlos. **Functional Training. Human Kinetics**. 2016
7. Arnold G. Nelson & Jouko Kokkonen, **Stretching anatomy**. Human Kinetics. 2007.
8. Edmund O. Acevedo and Michael A. Starks. **Exercise Testing and Prescription lab Manual,** USA: Human Kinetics Publishers, 2003.
9. Claudio Gil Soares de Araujo. **Flexi test,** USA: Human Kinetics Publishers, 2004.
10. Thomas and Roger. **Essentials of strength training and conditioning,** 3rd edition, Human Kinetics, 2008.
11. Hoffman, J. (2006**). Norms for Fitness, Performance, and Health**. Human Kinetics. USA
12. Tomchuk, D. (2011). **Companion Guide to Measurement and Evaluation for Kinesiology**. Jones & Bartlett Learning. London UK
13. Johnson, J. (2012). **Postural Assessment**. Human Kinetics. USA
14. Miller, T. (2012) **NSCA's Guide to Tests and Assessments** United States, Human Kinetics

Course Outcomes

CO No	Course outcomes
CO 1	Learn the importance of test, measurement and evaluation in sports
CO 2	Understand the norms and criteria of constructing a standard test and learn about test Batteries
CO 3	Acquire the skills to test the anthropometry and physiological tests
CO 4	Acquire the skills to measure health related and skill related fitness tests
CO 5	To acquire the skills to conduct sports specific fitness tests

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT201

HUMAN ANATOMY AND PHYSIOLOGY -II

Learning Objectives:

1. By learning the subject, the students will be aware of the various anatomical structures present in Human body.
2. The students after learning will gain knowledge about the normal functioning of various organs in Human body.
3. Only after knowing about normal functioning of the human body the students will the students will know about effect of exercise on various system.

UNIT-I- Digestive system - Mouth and its parts. Teeth - Classification, types and function. Salivary Glands – Position, types and function. Gastro Intestinal Tract - Esophagus, Stomach, Small intestine, Large intestine and Anus - Structure and function. Pancreas structure and Digestive function. Liver - structure and function. Secretion of Enzymes for Digestion in Gastro Intestinal Tract.

UNIT-II- Endocrine systems- Definition and classification. Anterior Pituitary hormones and their functions - Posterior Pituitary hormones and their actions - Thyroid hormones, Biosynthesis and functions - Parathyroid hormones, functions, Adrenal cortex hormones and their functions. Adrenal medullary hormones and their actions, Pancreas, Thymus Gland, Ovary and Testis.

UNIT-III- Nervous System-Definition and Classification. Neuron –Definition and types. Central Nervous Systems - Structure and Function of Cerebrum, Cerebellum, Pons, Hypothalamus, Medulla Oblongata and Spinal Cord. Peripheral Nervous Systems-Sensory and Motor nerves and impulses. Autonomic Nervous Systems- Sympathetic and Parasympathetic nervous systems. Cranial Nerves-Types and functions. Reflex action-Definition, Explanation and example.

UNIT-IV- Male and Female Reproductive Organs- Structure and Function of External genitalia, Ovary, Uterus and Fallopian tubes. Ovum – Definition and Structure. Male Reproductive OrgansStructure and Function of External genitalia, Epididymis, Vasdeferans, Prostate gland and Testis.

Sperm - Definition and Structure.

UNIT-V Excretory system - Kidney- Structure and functions. Nephron - structure and functions. Mechanism of Urine formation. Skin- Structure and functions. Eye - Structure and functions. Ear - Structure and functions.

Reference Books:

1. Jason LaPres, Beth Kersten and Yong Tang, (2016), Gunstream's Anatomy & Physiology: With Integrated Study Guide, Sixth Edition, McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121.
2. Cinnamon L. Van Putte, Jennifer L. Regan & Andrew F. Russo, (2017), Seeley's Anatomy & Physiology, Eleventh Edition, McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121.
3. Clancy, John & Andrew J.McVicar (1995), "Physiology & Anatomy – A Homeostatic Approach", London: Edward Arnold, A Division of holder head line PLC.
4. Guyton, A.C. (1979) Physiology of the Human Body. 5th ed. Saunders College of Publishing, Philadelphia. **Course Outcomes**

CO No	Course outcomes
CO 1	Describe the structure and functions of Digestive system in the body
CO 2	Evaluate the role of the endocrine system in regulating the activities of other systems.
CO 3	Evaluate the role of the nervous system in regulating the activities of other systems.
CO 4	Describe the structure and functions of reproductive system in the body.
CO 5	Identify the microscopic structure, label the parts of primary organs in the body such as Kidney, Skin, eye and ear.

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT202

PHYSICS FOR BIOMECHANICS Learning

Objectives

1. To learn about fundamentals of physics and SI Units
2. To learn the laws of motion and projectiles
3. To learn about optics and acoustics
4. To learn about fluid dynamics and electricity and semi-conductors

Unit – I

Units and Measurement: Branches in Physics - Role of Physics in Sports and Biological System - SI Base Quantities and Units - Fundamental and Derived Quantities and their Units - Measurement of different quantities - Accuracy and Precision - Error Analysis - Significant and round off – Dimensional Analysis - Application of Unit and Measurements in sports.

Unit -II

Laws of Physics and Motion: Rest and Motion - Displacement and Distance - Velocity and Acceleration - Momentum – Force and Reaction - Moment, Torque and Couple - Free Fall and Vertical upward motion – Projectile Motion (Horizontal Projectile and Angular Projectile) - Circular Motion - Inertia and mass - Angular velocity and Acceleration - Kinematic of circular motion - Application of Laws of Motion and application of projectile motion in ball sports. Work, power and energy.

Unit III

Optics and Acoustic: Law of Reflection - Types of the lens - Laws of Refraction - Types of Mirror - Prism - Snell's Law- Refractive Index - Human Eye - Working Principle of Optic Fibre - Hygen's Principle - Coherent and Incoherent - Nature of Sound - Difference between Sound and Light - Types of Wave - Echo - Noise cancellation Technique - Human Ear - Resonance - Application of optics in binocular, Range finder in golf and archery sight - Application of acoustic in Sport indoor stadium or hall.

Unit IV

Applied Fluid Dynamics and Solid Mechanic: Fluid Dynamics Terminology - Types of Fluids - Viscosity effect based on Temperature - U-Tube manometer - Pascal Law - Bernoulli's principle - Drag and Lift - Types of Material - Stress and Starin - Hooks Law - Types of Stress and Strain - Factor of Safety - Types of Modulus. Role of Fluid Dynamics in water sports - Role of Aerodynamics in Cycling - Role of Solid Mechanics in Sports Helmet and Pole Vault.

Unit V

Electricity and Semiconductors - Basic Electricity Terminology - Circuit - Series and Parallel Connection - Power - Heating effect - of Current- Energy Consumption - AC and DC Current - Types of Battery - Semiconductor - Energy Level - P and N Type - Doping - Types of diodes - Application of Semiconductor.

Reference

1. John D. Cutnell and Kenneth W. Johnson, Introduction to Physics, Wiley, 10th Edition.
2. H C Sharma, Concept Physics: Part I, 2016 Edition.
3. H C Sharma, Concept Physics: Part II, 2016 Edition

Course Outcomes

CO No	Course outcomes
CO 1	Describe the fundamentals of physics and SI units
CO 2	Evaluate the role of the Laws of motion
CO 3	Evaluate the role of projectiles
CO 4	Describe the optics and acoustics
CO 5	Identify the importance of electricity and semi-conductors

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CE202
MATHEMATICS FOR BIOMECHANICS

Learning Objectives:

1. To learn and understand about Matrix and basic algebra
2. To understand sets and function and trigonometry
3. To Learn about integral calculus
4. To learn about complex numbers

Unit I

Matrix and Determinants: Definition - Order or size of a matrix - Types of a matrix, Row matrix, Column matrix, Square matrix, Diagonal matrix, Triangular matrix, Scalar matrix, Identity (or) unit matrix, Zero matrix (or) Null matrix, Equality of matrix, Transpose of matrix - Scalar multiplication - System of linear equation (Gaussian elimination) - Determinants. **Basic Algebra:** Real number system - Absolute value - Linear inequalities - Quadratic functions – Polynomial functions - Rational functions - Exponents and radicals - Logarithm.

Unit II

Sets and Function: Definition - Types of the set (finite set, infinite set, empty set, singleton set, equal set, equivalent set, power set, universal set, subset) - properties of a set - set operation
(union of set, intersection of set, complement of set, Cartesian product of set, difference of set) - Constants and Variable Functions- Relation - Graphing functions using transformations.

Trigonometry: Introduction of trigonometry - Understanding trigonometry, Trigonometry ratio - Graph of Trigonometric function - Trigonometric identities - Radian measure - Solution of triangle - Properties of triangle - Application to triangle - Inverse trigonometric functions - Principal Value of Inverse Trigonometric Functions - Properties of Inverse Trigonometric Functions – Measuring Heights, depth and Distance - Application of trigonometry in Sports.

Unit III

Two-Dimensional Analytical Geometry, Sequences and Series: Introduction - Locus of Point - Straight lines - Angle between two straight lines - Pairs of straight lines - Finite sequences and series - Infinite sequences and series. **Vector Algebra:** Definition - Scalar, Vector, Magnitude of a vector, Equality of vector - Types of vector – Zero (or) Null Vector, Unit Zero, Like and Unlike vector, Co-initial vector, Co- terminal vector, Collinear or Parallel vector, Coplanar vector,

Negative vector) - Addition of vector, Parallelogram law of addition of vector, Position vector, Properties of multiplication of vector by a scalar. **Differential Calculus:** Limits - Continuity - The concept of derivative - Differentiability and Continuity - Differentiation rules - Meaning of Derivatives - Mean Value Theorem - Series Expansions - Indeterminate Forms - Applications of First Derivative, Second Derivative and Optimization - Symmetry and Asymptotes - Sketching of Curves.

Unit IV

Partial and Ordinary Differential: Linear Approximation and Differentials - Functions of Several Variables - Limit and Continuity of Functions of Two Variables - Partial Derivatives - Approximation - Differential Equation, Order, and Degree - Classification of Differential Equations - Formation of Differential Equations - Solution of Ordinary Differential Equations - Solution of First Order and First-Degree Differential Equation - First Order Linear Differential Equations - Applications of First Order Ordinary Differential Equations.

Unit V - Integral Calculus and Application

Newton-Leibnitz Integral - Basic Rules of Integration - Integrals of the form f(ax + b) - Properties of Integrals - Methods of Integration - Fundamental Theorems of Integral Calculus and their Applications - Bernoulli's Formula - Improper Integrals - Reduction Formulae - Gamma Integral - Evaluation of Bounded Plane Area by Integration - Volume of a Solid obtained by Revolving Area about an Axis. **Complex Number:** Complex Numbers - Basic Algebraic Properties of Complex Numbers - Conjugate of a Complex Number - Modulus of a Complex Number - Geometry and Locus of Complex Numbers – Polar and Euler form of a Complex Number - de Moivre's Theorem and its Applications

Reference

1. **Mathematics For B.Sc Branch-L** Third Volume- Lll **P.Kandasamy, K.Thilagavathi**
2. **"Calculus Volume 1"** Senior Contributing Authors Edwin "Jed" Herman, University Of Wisconsin-Stevens Point Gilbert Strang, Massachusetts Institute Of Technology
3. "**An Introduction To Numerical Methods And Analysis** " Second Edition James F. Epperson Mathematical Reviews.
4. 1. **Allied Mathematics vol- I** agasthiyar publication Dr.M.k. Venkataraman, Dr. Manorama Sridhar

5. "**Basic set theory**" Bertrand Arthur William Russell, 3rd Earl Russell, OM, FRS (18 May 1872-2 February 1970)
6. "**The theory of matrix" volume- I** F.R. Gantmacher cheslsea publishing company

Course Outcomes

CO No	Course outcomes
CO 1	Describe the fundamentals of matrix and algebra
CO 2	Acquire the skills of algebra calculation and differential calculus
CO 3	To learn about partial and ordinal differential
CO 4	Describe the integral calculus and application
CO 5	Identify the importance of complex numbers

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE : 23UD1CT301
KINESIOLOGY

Learning Objectives:

1. To make students understand the in foundations of kinesiology.
2. To make them aware about the fundamental movement of human body.
3. To make them learn the role and functions of muscles.
4. To enable them to learn the exercise program to strengthen and stretch the muscles.
5. To make them to acquire a strong foundation in kinesiology.

Unit-I

Kinesiology, meaning, history, scope and importance- muscle fiber architecture- uni-joint, two joint and multi joint muscles factors affecting muscular force generation; force velocity relationship, length tension relationship, electromechanical delay - functional role of skeletal muscles- planes and axis – fundamental movements of joints – role of muscles.

Unit-II

Structure of shoulder joint and shoulder girdle - origin, insertion and action of shoulder joint muscles and shoulder girdle muscles- - common injuries of the shoulder- Exercise program to stretch and strengthen the shoulder joint muscles. Structure of elbow joint- and wrist joint - Origin, insertion and action of elbow joint and wrist joint muscles- common injuries of elbow and wrist- Observation, palpation, and manual muscle testing - Range of motion assessment and joint mobility. Exercise program to stretch and strengthen the elbow joint and wrist joint muscles.

Unit-III

Structure of pelvic girdle and hip joint - Origin, insertion and action of pelvic girdle and hip joint muscles- common injuries of hip joint - Observation, palpation, and manual muscle testing - Range of motion assessment and joint mobility. Exercise program to stretch and strengthen the pelvic girdle and hip joint muscles.

Unit-IV

Structure of knee joint and ankle joint - Origin, insertion and action of knee and ankle joint muscles- common injuries of knee and ankle - Observation, palpation, and manual muscle testing - Range of motion assessment and joint mobility. Exercise program to stretch and strengthen the knee and ankle joint muscles joint muscles

Unit-V

Structure of spinal column - Origin, insertion and action of spinal column muscles- Common injuries of spinal column-Exercise program to stretch and strengthen the spinal column muscles joint muscles. Observation, palpation, and manual muscle testing - Range of motion assessment and joint mobility. Kinesiological analysis of fundamental movements.

Reference:

1. Kathryn Lutgens et al. **Kinesiology (Scientific Basis of Human Motion)**, Brown and Bench mark, 1992.
2. Robert Frost. **Applied Kinesiology.** Berkeley.2002.
3. Christy Cael. **Functional anatomy,** Lippincott.2010.
4. Joseph.E. Muscolino. **The Muscular System Manual (3rd edition).** Elsevier, 2010.
5. Pamela K Lavange & Synthia C. Norkin. **Joint structure & function.** F.A. Davis company, 2005.
6. Donald A. Newmann. **Kinesiology of Musculoskeletal System**. Mosby.
7. Bernard Kingston. Understanding muscles. Chapman & Hall
8. Susan J. Hall, **Basic Biomechanics**, McGraw Hill Education, 2004.
9. Lynn S. Lippert. Clinical kinesiology and anatomy (4th edition). F.A. Davis Company. 2006.
10. Roger Bartlett, **Introduction to Sports Biomechanics Analyzing Human Movement Patterns**, Routledge, 2007.

Course Outcomes

CO No	Course outcomes
CO 1	Describe the basic kinesiological concepts
CO 2	Understand the joints movements
CO 3	To learn about origin and insertion of muscles
CO 4	Describe the basic analysis of fundamental movements
CO 5	Identify the importance stretch and strengthening program in various joint muscles

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT302
BASIC BIOMECHANICS

Learning objectives:

1. To enable the students to learn the basic concept of biomechanics.
2. To make the students to understand kinematic and kinetic concept of human movement.
3. To equip the students to learn the principle of aerodynamic and hydrodynamics.
4. To enable the students to acquire the skills of qualitative and quantitative of human movement.

Unit-I

Biomechanics – Sports Biomechanics- branches of biomechanics; statics, dynamics, kinematics, kinetics-Definition - Meaning - Scope - Need and importance of Biomechanics - Historical development of Sports Biomechanics - Scholarly societies-International Journal of sports Biomechanics-International society of Biomechanics-American society of biomechanics-Canadian society of biomechanics-European society of biomechanics-AAPHERD-ACSM-Journals in Biomechanics.

Unit-II

Kinematic concepts for analyzing human movement - Kinematics; linear and angular kinematics-distance, displacement, speed, velocity and acceleration-forms of motion, linear motion, angular motion and general motion- tools for measuring kinematic quantities- common units of kinematic quantities. Kinetic concepts for analyzing human movement- Inertia, mass, force, net force, centre of gravity, weight, pressure, volume, density, specific weight, torque, impulse- common units of kinetic quantities-mechanical loads on the human body; compression, tension and shear force- mechanical stress' torsion, bending and combined loads- scalar, vector, composition and resolution, graphic solutions of vector problems- trigonometric solutions of vector problems- tools for measuring kinetic quantities

Unit-III

Linear kinematics of human movement - Linear kinematics- kinematics of projectile motion; horizontal and vertical components, influence of gravity, influence of air resistance- factors affecting projectile trajectory; projection angle, projection speed, relative height of release, optimum projection conditions, analysing projectile motion, equations of constant acceleration.

Angular kinematics of human movement - Angular kinematics- measuring angles-relative and absolute angle-tools for measuring body angles- instant centre of rotation- angular kinematic relationship-; angular distance and displacement, angular speed and velocity, angular acceleration-relationship between linear and angular motion; linear and angular displacement, linear and angular velocity, linear and angular acceleration

Unit-IV

Linear kinetics of human movement - Newton laws; Law of inertia, law of acceleration and law of acceleration- law of gravitation- mechanical behaviour of bodies in contact; friction, static friction, kinetic friction, coefficient of friction- momentum – impulse- impact- coefficient of restitution- work, power and energy relationship- conservation of mechanical energy- principle of work and energy. Equilibrium and human movement - Torque, moment arm, couple, resultant joint torque, levers; types of levers, anatomical and mechanical levers- equations of static equilibrium- equations of dynamic equilibrium, centre of gravity and location of centre of gravity, location of human body centre of gravity; reaction board, segmental method- stability and balance. Angular kinetics of human movement - Resistance to angular acceleration; moment of inertia, determining moment of inertia, human body moment of inertia- angular momentum; conservation of angular momentum, transfer of angular momentum, change in angular momentum, angular analogues of Newton laws of motion-centripetal force and centrifugal force

Unit-V

Human movement in a fluid medium- The nature of fluids; fluid, relative motion, relative velocity, laminar and turbulent flow, fluid properties- buoyancy; characteristics of buoyant force,

Archimedes's principle, centre of volume, floatation- drag, coefficient of drag, skin friction, surface drag, viscous drag, form drag, profile drag, pressure drag, wave drag- lift force, coefficient of lift, foil, Bernoulli principle, angle of attack, lift drag ration- Magnus effect- Propulsion in fluid medium, propulsive drag theory, propulsive lift theory, vortex generation and stroke technique. Basic mathematic and related skills - Negative numbers, exponents, square roots, order of operations, use of a calculator, percentages, simple algebra, measuring angles, trigonometric functions, common units of measurement, anthropometric measurements for the human body.

Reference Books:

1. Paul Grimshaw et al. Sports & Exercise Biomechanics, Taylor & Francis Group, (2007).
2. Susan J. Hall, Basic Biomechanics, McGraw Hill Education, 2004.
3. Peter McGinnis Biomechanics of Sport and Exercise, Human Kinetics, 2005.
4. Kathryn Lutgens et al. Kinesiology (Scientific Basis of Human Motion), Brown and Benchmark, 1992.
5. Roger Bartlett. Introduction to Sports Biomechanics Analyzing Human Movement Patterns, Routledge, 2007.
6. Roger Bartlett. Introduction to Sports Biomechanics, Spon Press, 1997
7. Knudson Duane V. Fundamentals of biomechanics, Springer, 2007.
8. Tomothy et al. Applied anatomy and biomechanics in sport (2nd edition), Human Kinetics, 2009
9. Steven T. McCaw. Biomechanics for dummies, John Wiley, 2014.
10. Anthony J. Blazevich. Sports Biomechanics (2nd edition), Bloomsbury, 2012.

Web links:

1. -http://www.sportsbiomech.com/aboutsportsbiomech.php
2. www.isb.com
3. www.clinbiomech.com

CO No	Course outcomes
CO 1	Describe the basic biomechanics concepts
CO 2	Understand the kinematics and kinetics
CO 3	To learn about fluid mechanics
CO 4	Describe the basic linear and angular kinematics
CO 5	Identify the importance basic mathematics in biomechanics

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT302

BASIC BIOMECHANICS

Learning objectives:

1. To enable the students to learn the basic concept of biomechanics.
2. To make the students to understand kinematic and kinetic concept of human movement.
3. To equip the students to learn the principle of aerodynamic and hydrodynamics.
4. To enable the students to acquire the skills of qualitative and quantitative of human movement.

Unit-I

Biomechanics – Sports Biomechanics- branches of biomechanics; statics, dynamics, kinematics, kinetics- Definition - Meaning - Scope - Need and importance of Biomechanics - Historical development of Sports Biomechanics - Scholarly societies-International Journal of sports Biomechanics-International society of Biomechanics-American society of biomechanics-Canadian society of biomechanics-European society of biomechanics-AAPHERD-ACSM-Journals in Biomechanics.

Unit-II

Kinematic concepts for analyzing human movement - Kinematics; linear and angular kinematics- distance, displacement, speed, velocity and acceleration-forms of motion, linear motion, angular motion and general motion- tools for measuring kinematic quantities- common units of kinematic quantities. Kinetic concepts for analyzing human movement- Inertia, mass, force, net force, centre of gravity, weight, pressure, volume, density, specific weight, torque, impulse- common units of kinetic quantities- mechanical loads on the human body; compression, tension and shear force- mechanical stress' torsion, bending and combined loads- scalar, vector, composition and resolution, graphic solutions of vector problems-trigonometric solutions of vector problems- tools for measuring kinetic quantities

Unit-III

Linear kinematics of human movement - Linear kinematics- kinematics of projectile motion; horizontal and vertical components, influence of gravity, influence of air resistance- factors affecting projectile trajectory; projection angle, projection speed, relative height of release, optimum projection conditions, analysing projectile motion, equations of constant acceleration. Angular kinematics of human movement - Angular kinematics- measuring angles-relative and absolute angle-tools for measuring body angles- instant centre of rotation- angular kinematic relationship-; angular distance and displacement, angular speed and velocity, angular

acceleration- relationship between linear and angular motion; linear and angular displacement, linear and angular velocity, linear and angular acceleration

Unit-IV

Linear kinetics of human movement - Newton laws; Law of inertia, law of acceleration and law of acceleration- law of gravitation- mechanical behaviour of bodies in contact; friction, static friction, kinetic friction, coefficient of friction- momentum – impulse- impact- coefficient of restitution- work, power and energy relationship- conservation of mechanical energy- principle of work and energy. Equilibrium and human movement - Torque, moment arm, couple, resultant joint torque, levers; types of levers, anatomical and mechanical levers- equations of static equilibrium- equations of dynamic equilibrium, centre of gravity and location of centre of gravity, location of human body centre of gravity; reaction board, segmental method- stability and balance. Angular kinetics of human movement - Resistance to angular acceleration; moment of inertia, determining moment of inertia, human body moment of inertia- angular momentum; conservation of angular momentum, transfer of angular momentum, change in angular momentum, angular analogues of Newton laws of motion- centripetal force and centrifugal force

Unit IV

Theory of information processing in the performance of motor skills

Basic models of information processing: display, sensory information, sense organs, perception, decision making, effector mechanism response and feedback- Memory: basic model of the memory process: selective attention, short term sensory store, short term memory, long term memory - Reaction time : definitions of reaction time, movement time and response time - importance of a short reaction time -factors affecting reaction time, including psychological refractory period, in a range of sporting activities - Feedback - importance and functions of feedback - types of feedback to include: intrinsic and extrinsic, terminal and concurrent, positive and negative, knowledge of performance, knowledge of results- use of practical examples to show how feedback can be used effectively to improve performance.

Unit V

Phases of learning movement skills - Cognitive, associative, autonomous phases of learning - characteristics of each phase and their practical implications- Transfer of learning - definition of transfer of learning – types – Positive transfer – Negative transfer – Proactive and retroactive – Bilateral transfer- Motivation - definition of motivation - extrinsic and intrinsic motivation - -

effect of extrinsic rewards on intrinsic motivation- Theories related to arousal levels - drive theory -inverted U theory - drive reduction theory

Reference Books:

1. Honeybourne J. Acquiring Skill in Sport, Routledge, 2006.
2. McMorris T. Acquisition and Performance of Sports Skills, Wiley, 2004.
3. Magill R. Motor Learning, Concepts and Application, McGraw Hill, 2004.
4. Sharp B. Acquiring Skill in Sport, Sports Dynamics, 1992.
5. Williams H and Hodges N. Skill Acquisition in Sport, Routledge, 2004.
6. Paul E. Robinson. Foundations of Scientific Coaching. Routledge. 2010.
7. Don Gordon. Coaching Science. Learning Matters. 2009.

Course Outcomes

CO No	Course outcomes
CO 1	Describe the classification of skill
CO 2	Understand the motor skill development
CO 3	To learn about reinforcement
CO 4	Describe the information processing model
CO 5	Identify the phases of movement skills

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT401
HUMAN GAIT, POSTURE AND CORRECTIVE EXERCISE

Learning objectives:

1. Know the basic parameters of human gait
2. Characterize normal human gait
3. Know the methods of gait analysis and assessment
4. Sketch the normal ranges of motion of the various joints during a gait cycle.
5. Describe various types of pathological gait.
6. Identify causes and compensation mechanisms for pathological gait.
7. Describe measurements used in analysis of human movement.
8. Understanding human posture, deformities and corrective exercise .

Unit-I

Fundamentals of gait - Meaning of gait, gait cycle divisions, Rancho Los Amigos gait terminology. **Gait parameters -** Temporal variables - stance time, single limb and double support time, swing time, stride and step time, cadence, speed. Spatial variables- stride length, step length and width, degree of toe out. Joint motion – Sagittal, frontal and Transverse plane joint angles. **Functional sub divisions of gait cycle** - Passenger unit, locomotor unit. Locomotor functions – Propulsion, stance stability, shock absorption, energy conservation.

Unit-II

Normal gait – Ankle foot complex – motion, muscle control and functional interpretation. Knee - motion, muscle control and functional interpretation. Hip - motion, muscle control and functional interpretation. Head, trunk, and pelvis - motion, muscle control and functional interpretation. Arm - motion, muscle control and functional interpretation. Total limb function- initial contact, loading response, mid stance, terminal stance, pre-swing, initial swing, mid swing, terminal swing.

Unit-III

Pathological gait - Pathological mechanisms – deformity, muscle weakness, sensory loss, pain, spasticity. Abnormal gait - Structural impairment - leg length discrepancy, increased Q-angle, increased tibial torsion, increased pronation and supination of the foot. Functional impairment - Parkinson's gait, calcaneal gait, gluteus medius gait, gluteus maximus gait, antalgic gait, arthrogenic gait, ataxic gait, hemiplegic gait, scissors gait, foot drop gait, stiff knee gait, psoatic limp gait. Walking aids, types, prescription and indication.

Unit – IV

Kinematic methods of gait analysis - Observational gait analysis - Motion analysis – Qualitative analysis – Quantitative analysis – 2-Dimensional analysis, 3-Dimensional analysis - Motion marker systems- sagittal, coronal and transverse plane landmarks. Electro goniometers, Accelerometers. **Kinetic methods of gait analysis** – Electromyography – Ground reaction force and vector analysis – Instrumented walkways – Energy expenditure – normal walking speed, fast walking speed, and running.

Unit- V

Human Posture and corrective Exercise: Postural Assessment Techniques - Overview of postural assessment methods - Observation, plumb lines, and grids in assessing alignment - Use of technology for objective posture analysis- Normal and Abnormal Postural Patterns - **Examination of ideal and neutral posture -** Identification of common postural deviations - Relationship between postural deviations and biomechanical factors - **Muscular Imbalances and Posture** - Understanding the role of muscles in maintaining posture - Imbalances between agonist and antagonist muscles - Muscle length-tension relationships and their effect on posture - **Corrective Exercise Techniques** - Strengthening weak muscles and inhibiting overactive muscles - Mobility and flexibility exercises for improving posture - Integrating stabilization exercises into a program.

Reference Books:

1. NihatOzkay&Margareta Nordin. **Fundamentals of Biomechanics: Equilibrium, Motion and Deformation,** Springer International Publisher, 2017.
2. Margareta Nordin& Victor Hirsch Frankel. **Basic Biomechanics of the Musculoskeletal System,** Lippincott Williams & Wilkins, 2001.

3. Arthur E. Chapman. **Biomechanical Analysis of Fundamental Human Movement**. Human Kinetics, 2008.
4. David A. winter. **Biomechanics and Motor Control of Human Movement (4th edition).** john Wiley & sons, 2009
5. Jacquelin Perry. **Gait Analysis; Normal and Pathological functions** (2nd edition). SLACK incorporated, 2010.
6. Michael Whittle. **Gait Analysis; An Introduction,** Butterworth-Heinemann, 2007.

Course Outcomes

CO No	Course outcomes
CO 1	Describe the basics of gait and its phases
CO 2	Understand the normal gait
CO 3	To learn about abnormal gait
CO 4	Describe the assessment methods of gait
CO 5	Identify the human posture, deviations and corrective exercise

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT402
PHYSIOLOGY OF EXERCISE AND ERGOGENIC AIDS

Learning objectives:

1. To understand basic sports physiology and the physiological factors affecting health, fitness and performance.
2. To familiarize with knowledge of health and skill related components of physical fitness.
3. To explore how the body adapts sports & exercise activities.
4. To identify exercise needs of a person/team and design appropriate exercise interventions.

Unit I

Exercise physiology- definition, need and importance. Energy, work and power - Forms of energy- chemical, kinetic and potential- **ATP -** role, breakdown, re-synthesis of ATP- The principle of coupled reactions; exothermic and endothermic reactions- **ATP resynthesis:** three energy systems – ATP/PC (alactic) – The lactic acid system – The aerobic system - Detail required to include the type of reaction (aerobic or anaerobic), the chemical or food fuel used, the specific site of the reaction, the controlling enzyme, energy yield, specific stages within a system, and the byproducts produced

Unit II

Energy continuum

The type of exercise (duration and intensity) – the onset of blood lactate accumulation/OBLA) -The effect of the level of fitness, availability of oxygen and food fuels, and enzyme control on the energy system used - **The recovery process:** returning the body to its pre-exercise state - The oxygen debt / excess post exercise oxygen consumption (EPOC) - The alactacid and lactacid debt components, including the processes that occur and the duration of each component Replenishment of myoglobin stores and fuel stores, and the removal of carbon dioxide - implications of recovery process to be considered when planning training sessions, for example training intensities, work/relief ratios.

Unit III

Principles of training: Specificity, progression, overloads (FIT), reversibility, moderation, and variance - The physiological implications of a warm up and cool down (for example, reduce the delayed onset of muscular soreness – DOMS) - periodization of training to include the macro, meso and micro cycle- Awareness of the implications of the principles when applied to the candidate's own training.

Unit IV

Components of fitness

Aerobic capacity - Definition – factors affecting- training, age and sex - Methods of evaluating aerobic capacity (for example, multi-stage fitness test, PWC170 test) - Assessment of the candidate's own VO2 max., matching their result against the aerobic demand of their chosen activity -Types of training- continuous running, repetition running, fartlek and interval training - - Energy system and food/chemical fuels used during aerobic work - Physiological adaptations after aerobic training- **Strength -** Definition- types of strength – Strength endurance – maximum strength – Explosive/elastic strength – Static and dynamic strength -Factors affecting strength-, Types of training used to develop strength -The repetition, sets and resistance guidelines used to improve each type of strength - Use of multi-gym, weights, plyometrics and circuit/interval training (work intensity, work duration, relief interval, number of work/relief intervals)- Energy system and food/chemical fuels - physiological adaptations after training, including neural and physiological changes to skeletal muscle- physiological adaptation to flexibility , Body composition, Balance, coordination, Reaction time and speed training.

Unit V

Ergogenic aids - An awareness of current methods of performance enhancement - The effects of each aid - Which athletes would benefit from each aid - Nutritional aids: – Carbohydrate loading – Pre/post competition meals – Food/fluid intake during exercise: Use of creatine supplements Blood doping and recombinant erythropoietin (Rh EPO) - Effects of caffeine -Effects of alcohol - Anabolic steroids (e.g., Nandrolone)- Human growth hormone (HGH)

Reference Books:

1. Clegg C, **Exercise Physiology and Functional Anatomy**, Feltham Press, 1995.
2. McArdle W et al. **Essentials of Exercise Physiology**, Lippincott Williams and Wilkins, 2005.
3. Wilmore J and Costill D, **Physiology of Sport and Exercise,** Human Kinetics, 2004.
4. John Porcarie et al. **Exercise Physiology**. F.A. Davis company, 2015.
5. K. Birch, D. MacLaren. & K. George. **Sports & Exercise Physiology**. 2005

Course Outcomes

CO No	Course outcomes
CO 1	Describe the basics of exercise physiology
CO 2	Understand the energy
CO 3	To learn about abnormal gait
CO 4	Describe the assessment methods of gait
CO 5	Identify the human posture, deviations and corrective exercise

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COUSE CODE: 23UD1CE404

SCIENCE OF SPORTS TRAINING AND STRENGTH AND CONDITIONING

Learning objectives:

1. To understand the principles of sports training
2. To deign the training to improve fitness components
3. To design the periodization of sports training

Unit-I

Introduction of Sports Training; meaning and definition of Sports Training and Coaching. Aim and objectives of Sports Training. Concept and importance of Warm-up and Cooling-down. **Concept of Physical Fitness**; Health Related Fitness and Performance Related Fitness (HRF & PRF). Different components of physical fitness and their importance towards specific games and sports.

Unit-II

Methods of Training; - Continuous Method, Interval Method, Repetition Method, Fartlek Training, Circuit Training, Plyometric Training, Weight Training and others. **Training Load**; Classification and components of Training Load. Concept of Intensity, Density, Duration and Frequency of Exercise. Principle of Intensity and Volume of Stimulus. Relationship between Load and Adaptation. Overload; - Concept, Cause, Judgment and Remedies. **Flexibility and Mobility Training**: Importance of flexibility and mobility in strength training Static vs. dynamic stretching techniques - Strategies for improving joint mobility and muscle flexibility.

Unit-III

Resistance Training Techniques: Techniques for different types of resistance: free weights, machines, bodyweight - Proper form and safety considerations in strength exercises - Variations and modifications for different fitness levels - **Program Design for Strength and Hypertrophy -** Different goals: strength, hypertrophy, power, endurance - Repetition ranges, sets, rest intervals, and load selection - Designing effective workout routines. **Conditioning and Metabolic Training:** Cardiovascular conditioning methods: steady-state, interval, HIIT - Designing metabolic conditioning workouts - Integrating conditioning with strength training Biomechanics of Strength Training. Biomechanical principles relevant to strength exercises - Levers, force production, and mechanical advantages - Analysis of compound and isolation exercises.

Unit-IV

Method of Development of different Fitness Components; Endurance, Speed, Strength, Flexibility, Agility and Coordinative ability. Program Design for Strength and Hypertrophy - Different goals: strength, hypertrophy, power, endurance Repetition ranges, sets, rest intervals, and load selection - Designing effective workout routines - **Plyometric and Power Training** - Plyometric exercises and their benefits - Power development through Olympic lifts and explosive movements - Considerations for integrating plyometrics and power training - **Olympic Weightlifting Techniques** - Techniques and progressions for Olympic lifts (clean and jerk, snatch) - Teaching proper form and execution - Safety considerations and injury prevention

Unit-V

Training Programme and Planning: - Meaning and Types of Periodization. Aim and Concept of Periodization; - Preparatory Phase, Competitional Phase and Transitional Phase. Training Cycle; - Micro, Meso and Macro. Concept and Application of Technique, Tactic and Strategy. **Injury Prevention and Rehabilitation:** Identifying common strength training injuries - Prehabilitation strategies to reduce injury risk - Integrating rehabilitation exercises into training programs - **Special Populations and Considerations** - Strength training for youth, seniors, pregnant individuals, and athletes - Considerations for training clients with specific medical conditions - Tailoring programs for different fitness levels and goals.

Reference Books:

1. **ACSM's Health/Fitness Facility Standards and Guidelines**, New York: Human, Kinetics, 1992.
2. **ACSM's Health related Physical Fitness Assessment manual**, Lippin Cott, 2008.
3. Michael Boyle. **Functional Training for Sports.** Human Kinetics, 2004.
4. Clake, H. Harrison. **Application of Measurement to Health and Physical Education, New Jersey:** Prentice Hall Inc. 1976.
5. Jensen, Clayne, R & Cyntha C. Hirst. **Measurement in Physical Education and Athletics,** MacMillan Publishing co., Inc New York, 1982
6. Juan Carlos. **Functional Training. Human Kinetics**. 2016
7. Arnold G. Nelson & Jouko Kokkonen, **Stretching anatomy**. Human Kinetics. 2007.

8. Edmund O. Acevedo and Michael A. Starks. **Exercise Testing and Prescription lab Manual,** USA: Human Kinetics Publishers, 2003.
9. Claudio Gil Soares de Araujo. **Flexi test,** USA: Human Kinetics Publishers, 2004.
10. Thomas and Roger. **Essentials of strength training and conditioning,** 3rd edition, Human Kinetics, 2008.
11. Vern Gambatta. **Athletic Development**. Human Kinetics, 2007.
12. Ryan George. **Free weight training anatomy.** Ulysses Press. 2016.

Course Outcomes

CO No	Course outcomes
CO 1	Describe the principles of sports training
CO 2	Understand the components and fitness and sports science
CO 3	Acquire the skills of designing periodization
CO 4	Describe the assessment of various fitness parameters
CO 5	Identify the training for special population

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT501

APPLIED BIOMECHANICS

Learning Objectives:

1. To familiarize the students with basic electronic devices.
2. To introduce the students the basic properties of high-speed cameras and calibrations.
3. To enhance their ability to asses and analyse human locomotion.
4. To provide students with a strong mechanical foundation to acquire the professional competence, knowledge and skills.
5. To study electromyography and force platform used for kinetic quantity measurement
6. To provide knowledge about advanced equipment and their significant practical applications in biomechanics.

Unit-I Spots and exercise biomechanics- role and functions- research, scientific support services, education, consultancy- Analysis services; qualitative analysis, quantitative analysis- Procedures; ethics, pre analysis preparation, detailed reporting. **Sensors and Transducers:** Principles of sensors and transducers in biomechanics - Types of sensors: force, pressure, strain, acceleration, etc. - Calibration, accuracy, and reliability of sensors.

Unit-II

Motion Capture and Analysis: Overview of motion capture technologies - 2D and 3D mocap - Camera-based systems, marker placement, and data collection - Processing and interpretation of motion capture data- Marker less camera and procedures - Data Processing and Analysis. **Data acquisition systems and software tools -** Filtering, smoothing, and processing biomechanical data – IMU sensors and its uses in sports

Unit-III

Force and pressure measurement - Force platform- piezoelectric and strain gauge technology - calibration- 2D and 3D force plates. Force Measurement and Analysis. **Techniques for measuring ground reaction forces:** Instrumented treadmills, force plates, and load cells - Center of pressure analysis and force-time curves. **Pressure Measurement and Gait Analysis** - Applications of pressure sensors in biomechanics. Plantar pressure measurement, foot pressure distribution analysis - Role of pressure measurement in gait analysis.

Unit-IV

Surface electromyography- equipment considerations- data collection procedures; electrode configuration, location and orientation, skin preparation, cross talk- sampling- processing, analyzing and presenting EMG- reporting an EMG study. **Isokinetic dynamometry**-Applications of isokinetic dynamometry- mechanical basis of isokinetic dynamometry measurements- isokinetic equipment considerations- isokinetic experimental and data collection procedures- processing, analyzing and presenting isokinetic data- reporting an isokinetic study. Eye tracker and its uses in sports

Unit-V

Instrumentation for Sports Performance Analysis: Technologies for analyzing sports- specific movements - Use of wearable sensors, accelerometers, and GPS devices - Real- time feedback and performance enhancement. **Emerging Technologies in Biomechanical Instrumentation -** Overview of current trends and innovations - Wearable sensors, virtual reality, artificial intelligence - Implications for future biomechanical research and applications. **Prosthetics, Orthotics, and Assistive Devices:** Biomechanics in designing and fitting prosthetics and orthotics - Improving mobility and function through assistive devices - Case studies of innovative biomechanical solutions. **Biomechanics of Footwear:** Impact of footwear on gait, running, and jumping

mechanics - Components of sports footwear: outsole, midsole, upper - Designing and selecting footwear for different sports disciplines

Reference:

1. Paul Grimshaw et al.**Sports & Exercise Biomechanics,** Taylor & Francis Group, 2007.
2. Susan J. Hall. **Basic Biomechanics**, McGraw Hill Education, 2004.
3. Peter McGinnis. **Biomechanics of Sport and Exercise**, Human Kinetics, 2005.
4. Kathryn Lutgens et al. **Kinesiology (Scientific Basis of Human Motion)**, Brown and Bench mark, 1992.
5. Roger Bartlett. **Introduction to Sports Biomechanics Analyzing Human Movement Patterns**, Routledge, 2007.
6. Knudson, Duane V**. Fundamentals of biomechanics**, Springer, 2007.
7. Vladimir, Medved. **Measurement of human locomotion,** CRC Press, 2001
8. John Mc Lester, & Peter St. Pierre, **Applied biomechanics,** Thompson, 2008.
9. Carl J. Payton & Roger M. Bartlett, **Biomechanical evaluation of movement in sports and exercise**, Routledge, 2008.
10. Roger Bartlett. **Introduction to Sports Biomechanics,** Spon Press, 1997

Course Outcomes

CO No	Course outcomes
CO 1	Describe the role of biomechanist
CO 2	Understand the methods of analyzing 2D and 3D motion in sports
CO 3	Acquire the skills of assessing force data in force plate and EMG
CO 4	Describe the assessment of Isokinetic Dynamometer procedures
CO 5	Identify the future directions of biomechanics and applications in sports

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT502

RESEARCH METHODS AND STATISTICAL PROCESS IN SPORTS SCIENCES

Leaning objectives:

1. To equip students with a basic concept of research.
2. To enable the students to learn the sampling techniques.
3. To enable students to choose the most appropriate research method / design to address a particular research question.
4. To equip the students to prepare a research proposal for grants.
5. To enable the students to prepare a research thesis/report/article for a journal.
6. To enable the students to learn the basic concepts of statistics.
7. To acquire the skills of parametric and non-parametric statistical methods and apply the appropriate technique for a research data analysis.

UNIT-I

Fundamentals of Research- Meaning and Definition of Research, Scope of Research in sports sciences, Qualities and Characteristics of Scientific Research - Criteria for locating and selecting a research problem - Delimitations and Limitations of a problem- Hypothesis and its formulation - Sampling- Sampling and Population, Sampling Techniques - Characteristics of a good sample - Sampling errors- Types of Research based on purpose – Basic research, Applied research, Action research – Types of research based on methods – Descriptive research, Experimental research.

UNIT–II

Variables - Independent, Dependent, Extraneous and Intervening, Experimental, Control variables. Research design – Types of Research design – Single group design, Repeated measures design, Static group comparison, Random groups design, Post-test only random group design, Related groups design, Rotation group design, Quasi experimental design and Factorial design - Methods of Data Gathering and Sampling – Survey, Questionnaire, Interview, Case study, Observation, Opinionnaire.

UNIT-III

Chapterization of Thesis / Dissertation - Front Materials, Body of thesis, Back materials, Method of Writing research proposal, Thesis / Dissertation - Method of writing abstract, full paper for presenting in a conference, publishing in journals, Mechanics of writing Research Report, APA referencing style, Plagiarism.

UNIT- IV

Introduction to statistics types, classification and basic concepts of statistics – Levels of measurement - Measures of central tendency – Mean Median and Mode – Measures of variability - Range, Mean deviation Quartile Deviation and standard deviation. Introduction to Normal distribution – Normal curve – Characteristics of Normal Curve – Properties of Normal curve - Testing of Hypothesis: Hypothesis – Type I & II error- Parametric and Non parametric statistics.

UNIT- V

Test of significance of a single Mean – Difference between two means for small and large sample tests – paired t – test for difference of mean. One way and two way analysis of variance – Post hoc tests - Scheffe's, Newman, Duncan, Tukey – Analysis of covariance. Pearson product moment correlation – Rank order correlation – Bi-serial Correlation-bhi coefficient - Detrahoric correlation- Partial and Multiple correlation – Chi square – contingency coefficient - SPSS Package – Introduction and application – creating, saving and opening a data file – Data entry and analysis of descriptive statistics, dependent and independent t-test, one way and two way ANOVA, ANCOVA, Repeated Measure and correlation – Naming the variables – editing the output file.

Reference:

1. Clarke, David H. Clarke, Harrison H. **Research Process in Physical Education**, New Jersey: Prentice Hall Inc. 1984.
2. Jerry R. Thomas, Jack K. Nelson and Stephen J. Silverman., **Research Methods in Physical Activity** (5th Ed), New York: Human Kinetics. 2005.
3. Chris Gratton and Ian Jones**., Research Methods for Sports Studies,** London: Routledge, Taylor & Francis Group, 2004.
4. John W. Best and James V. Kahn., **Research in Education** (9th Ed.,), New Delhi: Prentice Hall of India Pvt. 2006.

5. Robertson .E Gordon D et al. **Research Methods in Biomechanics.** New York: Human Kinetics. 2004.
6. Darren George & Paul Mallery. **IBM SPSS Statistics 23 step by step**. Routledge. 2016.
7. Kathleen et al. **An introduction to statistical analysis in research.** Wiley. 2018.

Course Outcomes

CO No	Course outcomes
CO 1	Describe the basics of research
CO 2	Understand the methods of research
CO 3	Acquire the skills of sampling and proposal writing
CO 4	Describe the method of writing thesis
CO 5	Identify the statistical methods and applications in sports

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE :23UD1CT503
BIOMECHANICS OF TRACK EVENTS

Learning objectives:

1. To equip the students to learn fundamental skills and techniques of track events.
2. To familiarize with mechanical principles involved in skills and technique track events.
3. To understand and conduct the qualitative and quantitative analysis in track events.
4. To acquire the skills of reviewing the current research studies.

Unit-I

100m Sprint: History, legends, world record, skills, technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance. Types of Crouch Start – Bunch start- Medium start-Elongated start - Running – Stride length - Take-off distance - Flight distance - Landing Distance - Stride Frequency - Action of leg - Supporting phase-Driving phase - Recovery phase - Action of arms -Action of trunk - Finish - Types of Finish - Start - Running – Finish- Spikes – Types of spikes - Starting block.

Unit-II

200m Sprint and 400m Sprint: History, legends, world record, skills, technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance. Technique- key performance indicators

Unit III

Hurdles (100m, 110m hurdles): History, legends, world record, technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance. Hurdles – High Hurdles-Approach-take- off-Flight-Landing-Running between hurdles – Key performance indicators

Unit - IV

400 m hurdles: History, legends, world record, technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's

performance. Hurdles – High Hurdles-Approach-take-off-Flight-Landing- Running between hurdles - Key performance indicators .

Unit-V

Middle and Long Distance and Relays (800m, 1500m, 5000m, 10000m , and 4x100m and 4x400m): History, legends, world record, technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance - Key performance indicators

Reference:

1. **The Sports Book** (3rd Edition). D.K publishers.
2. Will Freeman. **Track & Field Coaching Essentials.** Human Kinetics. 2014.
3. Joseph. L. Rogers. **USA Track & Field Coaching manual.** Human Kinetics.2000.
4. Ed House Wright. **Winning track & field for girls.** Mountain Lion. 2010.
5. Tom Ecker. **Basic Track & Field Biomechanics (4th edition).** 2015
6. **The Olympic and World Records book**, Imagine Publishing, 2016.
7. James G. Hay, **Biomechanics of Sports Technique,** Prentice-Hall, 1993.

Course Outcomes

CO No	Course outcomes
CO 1	Describe the basics of research
CO 2	Understand the methods of research
CO 3	Acquire the skills of sampling and proposal writing
CO 4	Describe the method of writing thesis
CO 5	Identify the statistical methods and applications in sports

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE : 23UD1CT601

SPORTS PERFORMANCE ANALYSIS

Learning Objectives:

1. To make the students to learn the fundamental and advance strategies of performance analysis.
2. To enable the students to acquire the video capturing technique.
3. To make the students to learn and acquire the skills of using sports performance analysis software.
4. To enable the students to acquire the skills of sports performance analysis.
5. To enable the students to diagnose the strength and weakness of a player / team.
6. To create a platform for the students to choose sports perform analysis as a career.

Unit-I

Sports Performance analysis – meaning, need and importance of sports performance analysis, careers opportunities in sports performance analysis – purpose of sports performance analysis – match analysis, work rate analysis. Sports performance analysis methods and procedures

Unit-II

Notational Analysis - Sport-specific notational systems; computerised notational analysis; notation in individual sports; notation in team sports; augmented feedback through video- based technologies; modelling of competitive sport; analysis of structures of sports informing performance indicators; flowcharts and presentation models of sports performance; reliability and validity of notational data; data processing; probability analysis; literature searching; critical evaluation of literature.

Unit-III

Analysis of Sports Technique - Observation of movement; systematic models of qualitative technique analysis; deterministic models of technique analysis; principles of movement (position, orientation, velocity, acceleration, force production); quantitative analysis of performance; accepted 2D filming protocols; comparison to model proformas; assessment of reliability; justification of methods

Unit-IV

Athlete monitoring and analysis - Time-motion analysis in sport; analysis of athlete tracking systems; GPS and accelerometer analysis of training and competition; monitoring and analysis of sport-specific physical and psychological variables; physiological monitoring; external sources of data relating to sports performance; wind gauge, photo finish, hawk eye technology, goal line technology, hot spot, reliability of data and sources.

Unit-V

Softwares in sports performance analysis – Dartfish, Sports code, Quintic, Kinovea, and Longomatch. Technical requirements, installation procedure, tools, features and report generation.

Reference:

1. Hughes M. and Franks, I. Essentials of performance analysis in sport. Routledge. 2015..

2. McGarry, T., O'Donoghue, P. and Sampio J. Handbook of sports performance analysis. Routledge. 2013.

3. Peter & Lucy. Data analysis in sports. Routledge. 2015.

Course outcomes

CO No	Course outcomes
CO 1	Describe the basics of research
CO 2	Understand the methods of research
CO 3	Acquire the skills of sampling and proposal writing
CO 4	Describe the method of writing thesis
CO 5	Identify the statistical methods and applications in sports

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT602

BIOMECHANICAL ANALYSIS OF SPORTS AND GAMES – PART I

Learning objectives:

1. To provide the acquaintance about the history of games, legends, skills and technique.
2. To recognize the mechanical principles involved in various skills of a game.
3. To acquire the skills with conducting research and evaluate the data on particular skill and technique in the relevant game.
4. To enable the students to learn to prepare standard biomechanical analysis report.

Unit-I

Basketball and Handball

History of the game, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - **Basketball**- Qualitative and Quantitative analysis- Dribbling, types of passes - Chest pass - Overhead pass - Bounce pass - Baseball pass, Types of shooting-Set shotJump Shot-Layup shot. **Handball** - Dribbling-Passing-types of passing- Overhead pass- Types of shot –Jump shot - Playing surfaces-Types

Unit-II

Volleyball and Kabaddi

History of the game, legends, skills and technique, application of biomechanical principles, analysis of related research reviews- **Volleyball**- Qualitative and Quantitative analysis- Serve, Types, Forearm pass Setting, Attack, Block, Floor defense - **Kabaddi**- offensive and defensive skills- match analysis.

Unit-III

Tennis and Table tennis

History of the game, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - **Tennis**- Qualitative and Quantitative analysis- Service, types of service- Rally – fore hand rally-Back hand rally-offensive and defensive techniques – Tennis Rackets –Types- Playing surfaces- **Table tennis**- Qualitative and Quantitative analysis-Grip, Stance, Footwork, Forehand drive, Backhand drive, Backhand push, Forehand push, Serve,

Return of serve, Basic strokes-Drive, Push, Block, Smash; Advance stroke – Loop, Chop, Flip and Lob **.**

Unit-IV

Badminton and Squash

History of the game, legends, skills and technique, application of biomechanical principles, analysis of related research reviews – **Badminton** - Qualitative and Quantitative analysis - grip, foot work, service and types; short, flick, high , drive - clears, drop shot, smash, drive, net play - **Squash**- Qualitative and Quantitative analysis, Racket Grip, Squash Swing (Forehand swing and back hand swing)

Unit-V

Swimming

History, legends, skills and technique, application of biomechanical principles, analysis of related research reviews-Swimming - Qualitative and Quantitative analysis – Free style, Front crawl, Butterfly, Breast stroke, and Back crawl.

Reference:

5. Hay, J. (1993). **The Biomechanics of Sports Techniques,** Benjamin Cummings.
6. Barth/Dietz. **Learning swimming,** Meyer & Meyer, 2002.
7. Cathy McGee, **Coaching Basketball-Technical and Tactical skills**, Human Kinetics, 2004.
8. Karen Palacios Jansen. **Golf fitness.** Taylor trade publishers, 2011.
9. Janusz Czerwinski & Frantisek Taborsky. **Basic handball**. European Handball Federation. 1997.
10. Renstrom. **Hand book of Sports Medicine and Science Tennis.** Blackwell science. 2002.
11. Philip Yarrow & Aiden Harrison. **Squash steps to success (2nd edition).** Human Kinetics. 2010.
12. Richard McAfee. **Table tennis-Steps to success.** Human Kinetics. 2009.
13. John Edwards. **Badminton**. Crow wood. 2014.
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Course Outcomes

CO No	Course outcomes
CO 1	Describe the basics of research
CO 2	Understand the methods of research
CO 3	Acquire the skills of sampling and proposal writing
CO 4	Describe the method of writing thesis
CO 5	Identify the statistical methods and applications in sports

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CT603

BIOMECHANICS OF SPORTS AND GAMES - II

Learning Objectives:

1. To enable the students to learn the basic skills and techniques of sports and games.
2. To learn and apply the mechanical principle on the technique of sports skill.
3. To understand the technique of qualitative and quantitative analysis.
4. To equip the students to carryout 3D analysis on sports skills and generate a valid report.

Unit-I

Hockey and football

History of the game, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - **Hockey**- Qualitative and Quantitative analysis – Dribbling- Pushing – Scooping-slap shot-Drag push and Drag flick- Hockey Sticks- Types of sticks- Playing surfaces - **Football**- Qualitative and Quantitative analysis - Kicking – instep kick-inside of the foot kick-passinginside of the foot pass- Receiving -Throw in- Dribbling – Heading-Volley.

Unit-II

Cricket

History of the game, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - Cricket- Qualitative and Quantitative analysis - batting: forward defense, backward defense, drives, cut, pull, and sweep - Bowling: Pace bowling, types and technique; medium pace, Spin bowling: types, leg spin, off spin and their improvisation – Fielding: catching, ground fielding, close and deep fielding- Wicket keeping.

Unit-III

Boxing and fencing

History, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - **Boxing**- Qualitative and Quantitative analysis- Foot work- a) Stand-up base b) Cross footwork c) Circling; Punches - a) Jab b) Cross c) Hook d) Uppercut; Blocks, parries and evasive techniques - a) Catch b) Side parry c) High front cover d) Low front cover e) Hook / side cover f) Shoulder roll g) Slip h) Duck i) Bob and weave - **Fencing**- Qualitative and Quantitative

analysis- Lunge (attacking) - flunge (saber fencing) - Passatta sotto (movement with a twist) - Parry (defensive move) - Counter attack (attack) - Riposte (counter attack) - Remise (series of attack) - Beat (attack) – Feint.

Unit-IV

Gymnastics

History, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - **Men -** Qualitative and Quantitative analysis -Floor exercise, parallel bar, horizontal bar, vaulting table. pommel horse and Roman rings – **Women -** Qualitative and Quantitative analysis -Uneven bars, Floor exercise, Balance beam and Vaulting table

Unit-V

Golf and cycling

History, legends, skills and technique, application of biomechanical principles, analysis of related research reviews - **Golf** - Qualitative and Quantitative analysis - carry-speed of release-Direction of Release-Height of release-Air resistance- The run-Putting- Techniques-Grip-Stance-The swingback swing-Down swing-Impact-Follow through - **Cycling**- analysis of velodrome and outdoor cycling events.

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2. Martin Toms. **Routledge International book of gold science**, Taylor & Francis, 2018.
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Course Outcomes

CO No	Course outcomes
CO 1	Describe the basics of research
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Mapping with Programme Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	S	L	M	S	M
CO 2	S	M	L	S	M
CO 3	S	M	M	S	S
CO 4	S	M	M	S	M
CO 5	S	S	M	S	S

COURSE CODE: 23UD1CE606

BIOMECHANICS OF YOGA

Learning Objectives

1. Helping learners to realize biomechanics importance to yoga practice;
2. To learn general biomechanics concepts and principles that influence human movement;
3. Illustrate the use of these general biomechanical concepts in the professional skill for the diagnosis of the movement during yoga practices.

Unit I

Introduction to Kinesiology and the principles of Biomechanics in Yoga

Meaning and Definition of Kinesiology ; Basic Biomechanical terms – velocity; acceleration; angular velocity; angular acceleration; Mass; Pressure; Gravity; Friction; work; Power; Energy; Torque; Bio mechanics: Description of movement of the human body; Kinematics, Kinetics; Kinetics – the forces producing motion e.g. muscles, gravity; Kinematics – the description of motion e.g. type, location, direction, planes of movement; Type of displacement (movement); Location in space; Direction of movement; Magnitude of movement; Rate of movement; Importance of Kinesiology and Biomechanics for Yoga

Unit II

Fundamental Concept

Fundamental concepts of following terms – Axes and Planes, Centre of Gravity, Equilibrium, Line of Gravity; Fundamental movements at various joints; Fundamental concepts of the following terms – Angle of Pull, All or None Law, Reciprocal Innervations and inhibition; Stretch and postural reflex during the practice of Yoga postures; Force – Meaning, definition, types and its application to various Yoga postures; Lever – Meaning, definition, types and its application to human body; Newton's Laws of Motion – Meaning, definition and its application to Yoga activities.

Unit III

Biomechanics of Hip and spine

Biomechanics of Hip Structure & function of the bones & non contractile element of the Hip, mechanics & patho-mechanics of muscle activity at the hip & analysis of the forces on the Hip during various Yoga postures; Biomechanics of Spine: Structure & function of the bones
& joints of the cervical spine, mechanics & patho-mechanics of the cervical musculature,

analysis of the forces on the cervical spine during activity, structure & function of the bones & joints of the thoracic spine, mechanics of the thoracic musculature, analysis of the forces on the thoracic spine during Yoga Postures & structure & function of the bones & joints of the lumbar spine. c. Mechanics of the lumbar musculature, analysis of the forces on the lumbar spine during Yoga postures, structure & function of the bones & joints of the pelvis, mechanics of the muscle activity in the pelvis & analysis of the forces on the pelvis during activity.

Unit -IV

Biomechanics of Shoulder, elbow and wrist Biomechanics of Shoulder: Structure & function of the bones & joints of the Shoulder complex, mechanics & patho-mechanics of the muscle activity in the Shoulder complex & analysis of the forces on the Shoulder complex during Yoga postures;

Unit-V

Biomechanics of Elbow: Structure & function of the bones & no contractile element of the elbow, mechanics of muscle activity at the elbow & analysis of the forces on the elbow during Yoga postures; Biomechanics of Wrist & Hand Structure & function of the bones & joints of the wrist & hand, mechanics of the muscle activity in the wrist & hand, analysis of the forces on the wrist during activity, mechanics of the Special connective tissue in the hand

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