

# **School of Sports Sciences**

## **Department of Sports Biomechanics**



### **Proposed Course Structure and Course Details**

## **M.Sc. Sports Biomechanics**

Central University of Rajasthan  
NH-8, Bandar Sindri, Kishangarh-305817  
Dist. – Ajmer (Rajasthan)

## M.Sc. Sports Biomechanics

### SEMESTER I (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSBM 101	Human Anatomy and Physiology	Core 1	4
MSSBM 102	Biomolecules and Metabolism	Core 2	4
MSSBM 103	Food and Nutrition	Core 3	4
MSSBM 104	Introduction to biomechanics	Core 4	4
MSSBM 105	Discipline Elective I	DE 1	4
MSSBM 106	Practicum I	P 1	2
MSSBM 107	Practicum II	P 2	2
MSSBM 108	Fitness		1
MSSBM 109	Societal		1

### SEMESTER II (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSBM 201	Kinesiology	Core 5	4
MSSBM 202	Psychological and Social Aspects of Sports	Core 6	4
MSSBM 203	Principles and methods of Sports Training	Core 7	4
MSSBM 204	Discipline Elective II	DE 2	4
MSSBM 205	Discipline Elective III	DE 3	4
MSSBM 206	Practicum III	P 3	2
MSSBM 207	Practicum IV	P 4	2
MSSBM 208	Fitness		1
MSSBM 209	Societal		1

### SEMESTER III (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSBM 301	Dynamics of Gait	Core 8	4
MSSBM 302	Mechanobiology	Core 9	4
MSSBM 303	Discipline Elective IV	DE 4	4
MSSBM 304	Discipline Elective V	DE 5	4
MSSBM 305	Elective I	E 1	4
MSSBM 306	Practicum V	P 5	2
MSSBM 307	Practicum VI	P 6	2
MSSBM 308	Fitness		1
MSSBM 309	Societal		1

### SEMESTER IV (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSBM 401	Discipline Elective VI	DE 6	4
MSSBM 402	Elective II	E 2	4
MSSBM 403	Dissertation		16
MSSBM 404	Fitness		1
MSSBM 405	Societal		1

- Any other Elective Courses introduced from time to time will be included in the Discipline Elective (DE) of the M.Sc. Programme.

### List of Elective papers offered by the Department

Code	Title of Course	Type of Course	Credits
MSSBM 105/204/205/303/304/305	Fatigue, Injuries and Rehabilitation	Elective	4
MSSBM 105/204/205/303/304/305	Essentials of Sports	Elective	4
MSSBM 105/204/205/303/304/305	Kinanthropometry	Elective	4
MSSBM 105/204/205/303/304/305	Health Fitness and Wellness	Elective	4
MSSBM 105/204/205/303/304/305	Research Methodology	Elective	4
MSSBM 105/204/205/303/304/305	Instrumentation and Techniques in Biomechanics	Elective	4
MSSBM 105/204/205/303/304/305	MATLAB	Elective	4
MSSBM 105/204/205/303/304/305	Biomechanics of Yoga Asanas	Elective	4
MSSBM 105/204/205/303/304/305	Biomechanical Applications in Sports Training	Elective	4
MSSBM 105/204/205/303/304/305	Application of Gross Anatomy in Sports	Elective	4
MSSBM 105/204/205/303/304/305	Instrumentation and Techniques in Biomechanics	Elective	4
MSSBM 105/204/205/303/304/305	Biomechanical Analysis of Athletics and Team Games	Elective	4
MSSBM 105/204/205/303/304/305	Biomechanical Analysis of Human Movements.	Elective	4
MSSBM 105/204/205/303/304/305	Statistics for Sports Science	Elective	4

## SEMESTER-I

**MSSBM 101**

**Human Anatomy and Physiology**

**Credit 4**

### Unit-I

Basis of cell biology; Anatomy and Physiology of Cardiovascular System Lymphatic System, Respiratory System and acute effects of exercise on cardiovascular, lymphatic and respiratory systems.

### Unit-II

Anatomy and Physiology of: Nervous System, Special Senses, Endocrine System, Musculoskeletal system and acute effects of exercise on Nervous, Endocrine, and Musculoskeletal systems.

### Unit-III

Anatomy and Physiology of: Digestive System, Immune System, Urinary System, Reproductive System, and Integumentary System and acute effects of exercise on Digestive, Immune and Urinary systems.

### Unit-IV

Anatomy and Physiology of: Reproductive System, and Integumentary System and acute effects of exercise on Reproductive System, and Integumentary System

### **Recommended Books:**

- Human Anatomy and Physiology (10<sup>th</sup> edition) by Elaine N Marieb, Katja N Hoehn.
- Introduction to Human Body- The Essentials of Anatomy and Physiology by Gerard J. Tortora
- Textbook of Anatomy with Coloured Atlas by Inderbir Singh
- Textbook of Medical Physiology by Arthur C. Guyton
- Principle of Human Anatomy (10<sup>th</sup> Edition) by Gerard J. Tortora.
- Gray's Anatomy: Anatomical Basis of Clinical Practice by Standring, Susan. Borley, Neil R. Gray Henry
- Human Physiology by C.C. Chatterjee
- Chowdhary Medical Physiology by S K Chowdhary
- Netter's Atlas of Human Anatomy by Frank H. Netter

**MSSBM 102**

**Biomolecules and Metabolism**

**Credit 4**

### Unit I

Foundation of Biochemistry: Biomolecules- chemical composition and bonding - chemical reactivity - buffers - buffering in biological systems. Principles of bioenergetics- Laws of thermodynamics and their applications in biological system – entropy and enthalpy

### Unit II

Carbohydrates-Monosaccharides- disaccharides- oligosaccharides- polysaccharides- structure and biological functions of homo- and heteropolysaccharides. Proteins-primary- secondary- tertiary and quaternary structure- Ramachandran plot;

### Unit III

Nature of enzymes- classification and nomenclature of enzymes Lipids- Classification- structure and properties- phospholipids- glycolipids-sphingolipids- cholesterol. Fatty acids- saturated and unsaturated fatty acids;Nucleic acids- types and structural organization- triple helix of DNA

### Unit IV

General introduction- Metabolism- Anabolism- Catabolism- Vitamins-Coenzymes.; Carbohydrates metabolism; Metabolism of Lipids; Metabolism of Proteins; Metabolism of Lactate, ; Major Metabolic Pathways in Human and its Relevance with Exercise: Citric Acid Cycle, Electron Transfer System in Mitochondria, Oxidative Phosphorylation

### **Recommended Books:**

- Principles of Biochemistry- Lehninger Nilson and Cox W.H. Freeman
- Principles of Biochemistry- Donald Voet, CW Pratt, JG Voet (2012) Wiley, ISBN:1118092449.
- Principles of Exercise Biochemistry Editor(s): Poortmans J.R. (Brussels) Karger Publishers
- Biochemistry JM Berg, TL Tymoczko L Stryer W. H. Freeman and Company
- West & Todd Text book of Biochemistry. Mac Millan Company London
- G.P. Talwar & ID Singh Textbook of Biochemistry & Human Biology - Prentice Hall of India, New Delhi.
- Vasudevan Textbook of Biochemistry. Jaypee Brothers Medical publishers (P) Ltd;
- Jain J.L., Jain Sanjay, Jain Nitin, S Fundamentals of Biochemistry – Chand and Company Ltd, New Delhi.
- A.C. Dev. Comprehensive Viva and practical Biochemistry. New Central Book Agency Pvt. LTD.

**MSSBM 103**

**Food and Nutrition**

**Credit 4**

### Unit-I

Nutrients and nutritional Role of macro and micro nutrients: Water Requirements and Fluid Balance, Nutrition Supplements. Gastric Emptying, Digestion, and Absorption.

### Unit-II

Nutrients: Functions and Recommended Intakes, Healthy Eating and Balanced Diet, Fuel Sources for Muscle and Exercise Metabolism, Energy: Food Energy and Expenditure.

### Unit-III

Nutrition and Immune Function in Athletes, Body Composition and Weight Management, Eating Disorders in Athletes,

### Unit-IV

Personalized Nutrition, Menu Planning (Meal Timing and Spacing); Principles of diet planning, Food data table and Usage of software, validity and reliability of dietary assessment tools, translating the dietary intake into analysis and determining nutritional information.

### **Recommended Books:**

- Sport Nutrition 3rd Edition by Asker Jeukendrup, Michael Gleeson, Human Kinetics, 2018.
- Nutrition for Sport, Exercise, and Health by Marie Spano, Laura Kruskall, D. Travis Thomas, Human Kinetics.
- Physiology of Sport and Exercise 6th Edition with Web Study Guide-Loose-Leaf Edition by W. Larry Kenney, Jack Wilmore, David Costill.
- Exercise Physiology: Nutrition, Energy and Human Performance 8th Edition by William D. McArdle, Frank I. Katch, Victor L. Katch
- Nancy Clark's Sports Nutrition Guidebook by Nancy Clark, Human Kinetics
- NSCA's Guide to Sport and Exercise Nutrition by National Strength Conditioning Association, Human Kinetics
- Fundamental of Foods, Nutrition & Diet Therapy 5<sup>th</sup> edition by S.R. Mudambi, M.V. Rajagopal, New Age International Limited, New Delhi.
- Applied Nutrition. By R. Rajlaxmi, IBH Publications, New Delhi.
- Nutritional Supplements in Sports, Exercise and Health: An A to Z Guide by Linda M. Castell, Smantha J. Stear, Louise M. Burke, Routledge.

Unit –I

Exercise and sports biomechanics basic concepts of kinematics and kinetics – vectors, motion, degrees of freedom, force, moment of force, equilibrium. Biomechanical considerations in reducing sporting injury rates.

Unit –II

Posture static and dynamic posture, postural diversity within individuals, posture and its relationship to somatotype posture assessment, desirable postures for high level sport performance, modifying posture and technique to improve performance.

Unit –III

Movement patterns – the essence of sports biomechanics, Qualitative analysis of sports movements, More on movement patterns – the geometry of motion, Quantitative analysis of movement, Causes of movement – forces and torques.

Unit-IV

Image analysis in sports performance errors in motion analysis, planar Video analysis, 3d motion analysis, data filtering.

**Recommended Books:**

- Clinical Mechanics and Kinesiology with web Resource, Human Kinetics, by Janice Loudon, Robert Manske, Michael Reiman.
- Biomechanics and Kinesiology of Exercise – 2013 by Michael Yessis.
- Cynthia C. Norkin, Pamela K. Levangie : Joint structure & function- A comprehensive analysis 2nd edition.
- Brunnstrom - Clinical Kinesiology, F.A. Davis.
- Rasch and Burk: Kinesiology and Applied Anatomy, Lee and Fabiger.
- Shaw, D., Pedagogic Kinesiology, Khel Sahitya Kendra, 2007.
- Thompson, C., Manual of Structural Kinesiology. (10th Ed.), St. Louis: Times Mirror/ Mosby College Publishing, 1995.
- Shaw, Dhanonjoy, Kinsiology and Biomechanics of Human Motion, Khel Sahitya Kendra, 1998.
- White and Punjabi - Biomechanics of Spine - Lippincott.
- Kapandji: Physiology of Joints Vol. I, II & III, W.B. Saunders.
- Luttgens K., Hamilton N.: Kinesiology – Scientific Basis of Human Motion 9th Edi.
- Basic Biomechanics 4th edition, susan J. Hall, MCGraw Hill.

MSSBM 105	Discipline Elective I	Credit 4
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**MSSBM 106****Practicum I****Credit 2**

- Introduction to laboratory techniques and good laboratory practices.
- How to Use microscopes.
- To determine the total Red Blood Corpuscles count.
- To determine the total Leucocyte Count in blood.
- To measure Blood Pressure of a subject in different positions
- Assessment of Iron Status of athletes (Hb estimation, Hematocrit, Transferrin, Ferritin and TIBC)
- Calculation of Energy expenditure
- Measurement of blood glucose
- Measurement of blood Lipid Profile
- Biochemical Assessment of Metabolites (Lactate and Urea).
- Biochemical Assessment of Enzymes.
- Biochemical Assessment of Hormones.

- BMI Estimation with and without software
- Assess Energy and Nutrient intake from Diet using suitable Software
- Estimation of sugars, iron, phosphate, vitamin C and organic acids in food.
- Estimation of protein concentration in food.
- To analyse various planes and axes of the body.
- To demonstrate the surface anatomy and muscle attachments of following bones: Clavicle, Scapula, Humerus, Radius, Ulna, Meta Carpals, Phalanges, Femur, Tibia , Fibula , Patella, Tarsals and metatarsals
- To demonstrate the following joints including corresponding muscles and movements of Upper Extremity: Acromioclavicular joint, Sternoclavicular joint, Shoulder joint, Elbow joint, Proximal Radioulnar joint, Distal Radioulnar joint, Wrist joint, Radio carpal joint, Thumb joint
- To demonstrate the following joints including corresponding muscles and movements of Lower Extremity: Hip joint, Knee Complex and Ankle joint.
- Demonstration and Estimation of Centre of Gravity of Human Body.
- Determination of Human Gait pattern.

MSSBM 108	Fitness	Credit 1
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MSSBM 109	Societal	Credit 1
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### SEMESTER-II

MSSBM 201

Kinesiology

Credit 4

#### Unit-I

Meaning of Kinesiology, Aims and Objectives of Kinesiology, Role of Kinesiology in Sports; Anatomical Position, Principles of Plane and Axis, Various types of movements

#### Unit-II

Bones: composition of bone, Kinds of bones (flat, long, short, irregular and sesamoid), Function of bones, Bone fracture and its types; General features of the following bones: Upper Extremities and Lower Extremities;

#### Unit III

Joints: Meaning and types of joints, Joint flexibility, Technique to increase the flexibilities, Structure, function, fundamental movements around major joints

#### Unit-IV

Introduction to Muscular System: Muscles and Tendons, Classification of muscles, Structure of Skelton muscle, classification of muscles basis of the fibre arrangement, Physiology and types of muscle contraction, Origin, Insertion and action of major muscle groups of the Body.

#### **Recommended Books:**

- Clinical Mechanics and Kinesiology With Web Resource, Human Kinetics, by Janice Loudon, Robert Manske, Michael Reiman
- Biomechanics and Kinesiology of Exercise – 2013 by Michael Yessis
- Cynthia C. Norkin, Pamela K. Levangie : Joint structure & function- A comprehensive analysis 2nd edition,
- Brunstrom - Clinical Kinesiology, F.A. Davis.
- Rasch and Burk: Kinesiology and Applied Anatomy, Lee and Fabiger.

- Shaw, D., Pedagogic Kinesiology, Khel Sahitya Kendra, 2007.
- Thompson, C., Manual of Structural Kinesiology. (10th Ed.), St. Louis: Times Mirror/ Mosby College Publishing, 1995
- Shaw, Dhanonjoy, Kinsiology and Biomechanics of Human Motion, Khel Sahitya Kendra, 1998
- White and Punjabi - Biomechanics of Spine - Lippincott.
- Kapandji: Physiology of Joints Vol. I, II & III, W.B. Saunders.
- Luttgens K., Hamilton N.: Kinesiology – Scientific Basis of Human Motion 9th Edi
- Basic Biomechanics 4th edition, susan J. Hall, MCGraw Hill.

## **MSSBM 202**

### **Psychological and Social aspects of Sports**

**Credit 4**

#### Unit-I

Sports Psychology and role of Psychology in Sports, Methods of Psychology employed in Sports, Motor leaning and Performance, Importance of Sports Psychology for Athletes, Coaches and other related to Sports settings

#### Unit-II

Personality and its role in Sports, Attention and Perception in Sports; Motivation and Goal setting and its role in Sports, Emotions in Sports, Stress and Anxiety in Sports, Biofeedback techniques in Sports

#### Unit-III

Sociology of Sports, Social Factors and Socio-metric techniques in Sports, Group processes, Team cohesiveness and Leadership in sports, Effect of crowd behaviour in Sports, Economics and Politics in Sports

#### Unit-IV

Concentration in sports, components, assessments, strategies of concentration. Knowledge of attentional control, Knowledge of attentional styles, mental preparation for sports performance, Commitment and confidence for sports performance.

#### **Recommended Books:**

- Weinberg & Gould, Foundations of Sports and Exercise Psychology. Human Kinetics 2016.
- Motor Learning and Performance 5th Edition With Web Study Guide From Principles to Application, Human Kinetics by Richard Schmidt, Tim Lee
- Morgan and King: Introduction to Psychology - Tata McGraw Hill.
- M.L. Kamlesh Psychology in Physical Education and Sports by Publisher Mehopolitan book co. Pvt. Ltd., Netaji Subash Marg, New Delhi 11002.
- Sanjeev. P. Sahni Psychology and its application in sports by, Publisher D.V.S. publications, 100, Giri Nagar Kalkaji, New Delhi-110019
- Agyajit Singh Psychology of coaching by, Friends Publications, # 101 Ansari Raod Darya Ganj, New Delhi-110002
- Jitendra Mohan Recent Advances in Sports psychology, By, Publisher, Friends Publications.
- Fundamentals of Sociology of Sport and Physical Activity, Human Kinetics by Katherine M. Jamieson, Maureen M. Smith
- Doing Exercise Psychology, Human Kinetics by Mark Andersen, Stephanie Hanrahan
- Social Issues in Sport 3rd Edition, Human Kinetics by Ron Woods

## **MSSBM 203**

### **Principles and methods of Sports Training**

**Credit 4**

#### Unit-I

Scientific basis of Sports Training, Importance, Aims and Objectives of Sports Training; Characteristics of Sports Training; Biological Process in Sports Training; Components of Physical Fitness (motor abilities) – Endurance, Strength, Speed, Flexibility, Coordination; Agility.

#### Unit-II



Methods of sports training: methods of development of various types of endurance, methods of development of various types of Strength, methods of development of various types of Speed.

### Unit-III

Principles of Sports Training - Overload, Specificity, Progression and Reversibility; Meaning and concept of Training load; Adaptation and Recovery, Super Compensation, Training Structure - Volume, Intensity, Frequency, Peaking, Errors in Training , Adaptations to Aerobic, Anaerobic and Resistance Training.

### Unit-IV

Training plan; Need and importance in planning; Types of training plans - short term and long term plans; Training and Competition Cycles (micro, meso, and macro); Periodization – Need, Types and various phases of Periodization (Preparatory, competition and transition); Competition -Types of Competition . Training athletes with disability, Adapted games for Disabled; Special Olympics and Paralympics

### **Recommended Books:**

- Physiology of Sport and Exercise 6th Edition with Web Study Guide-Loose-Leaf Edition by W. Larry Kenney, Jack Willmore, David Costill.
- Periodization-6th Edition Theory and Methodology of Training by Tudor Bompa, Carlo Buzzichelli.
- Physiological Aspects of Sport Training and Performance With Web Resource-2nd Edition, Human Kinetics By Jay Hoffman.
- Recovery for Performance in Sport by Institut National du Sport de l'Expertise et de la Performance INSEP, Human Kinetics, Christophe Hausswirth, A. Mujika.
- Essentials of Sports Training and Conditioning by JB Learning, NASM.
- Singh, H: Science of Sports training, DVS Publication, New Delhi, 1991.
- Matweyev, L.P.: Fundamentals of Sports training, publication Moscow, 1984.
- Harre, D: Principles of sports training, Sportverlag, Berlin, 1988.
- Singh, H: Science of Sports training: General theory and methods, NIS, Patiala, 1984.
- Scholisch, M: Circuit training, Sportverlag, Berlin.
- Willmore, J.H.: Athletic training and physical fitness, Antro and Becon Inc, Sydney.

<b>MSSBM 204</b>	<b>Discipline Elective II</b>	<b>Credit 4</b>
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<b>MSSBM 205</b>	<b>Discipline Elective III</b>	<b>Credit 4</b>
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<b>MSSBM 206</b>	<b>Practicum III</b>	<b>Credit 2</b>
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- Techniques of taking various anthropometric measurements
- To define and illustrate various body landmarks
- Gross body measurements: Body weight (Kg), Stature, sitting height, Height of interior superior Iliac spine, Subischial length.
- Diameters or Breadths (cms): Bicristal diameter (Shoulder Breadth), Transverse chest diameter, Antero-posterior chest diameter, Femur bicondylar diameter (knee breadth), Humerus Bicondylar diameter (elbow Breadth)
- Circumferences or Girths of body parts, Calf circumference, Thigh circumference, Waist circumference, Chest circumference
- Skinfold measurement and Body Fat Percentage calculations

<b>MSSBM 207</b>	<b>Practicum IV</b>	<b>Credit 2</b>
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- BROCKPORT test system, AAHPER health related physical fitness test, Philips JCR test for General motor ability testing
- Aerobic Power Field Assessments: Cooper 1.5-Mile Run/Walk Test and 12-Minute Run/Walk Test, Rockport Fitness Walking Test
- High-Intensity Fitness Testing: Léger 20 m Shuttle Run Test, Yo-Yo Intermittent Recovery Test, 30-15 Intermittent Fitness Test, Sprinting Performance, Jumping Performance,

- Power Endurance, Anaerobic Cycling Power, Margaria-Kalamen Stair-Climb Test.
- Tests for – Speed, Agility, Balance, Coordination, Reaction time, and Flexibility.
- Training Program: Circuit Training Program, Interval Training Program, Ballistic Training Program, Fartlek Training Program

<b>MSSBM 208</b>	<b>Fitness</b>	<b>Credit 1</b>
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<b>MSSBM 209</b>	<b>Societal</b>	<b>Credit 1</b>
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### **SEMESTER-III**

<b>MSSBM 301</b>	<b>Dynamics Gait</b>	<b>Credit 4</b>
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#### Unit-I

Normal Gait - Walking and gait, History, Terminology used in gait analysis, Outline of the gait cycle, The gait cycle in detail, Ground reaction forces, Support moment, Energy consumption, Optimization of energy usage, Starting and stopping, Other varieties of gait, Changes in Gait with Age, Pathological and other abnormal gaits - Specific gait abnormalities, Walking aids and Treadmill gait

#### Unit-II

Methods of gait analysis - Visual gait analysis, Temporal and Spatial Parameters during Gait Measurement of Temporal and Spatial Parameters during Gait, Camera Based Motion Analysis, Active marker systems,

#### Unit-III

Accelerometers, Gyroscopes, Magnetic Fields and Motion Capture Suits, Measuring Force and Pressure beneath the foot Measuring Muscle Activity Measuring Energy Expenditure Combined kinetic/kinematic systems

#### Unit-IV

Applications of gait analysis - Clinical gait assessment, Conditions benefiting from gait assessment, Applications in Sports Performance and Injury Prevention, Future developments and applications in Gait Analysis

#### **Recommended Books:**

- (1) Levangie PK, Norkin CC; Joint Structure & Function- A Comprehensive Analysis; Jaypee brothers, New Delhi; 2006.
- (2) Kapandji IA; The Physiology of Joints; Churchill Livingstone, Edinburgh; 1998.
- (3) Magee J D. orthopedic physical assessment. W.B. saunders ompany.
- (4) Grisaffi D. Posture and core conditioning Published by David Grisaffi
- (5) Kendall, F. P., McCreary, E. K., & Provance, P. G. (1993). Muscles Testing and Function (4th Ed). Baltimore: Williams &Wilkins.
- (6) Frank C C., Lardner assessment and treatment of muscle imbalance, human kinetics

Unit-I

Biomechanics as an Interdisciplinary, Introduction, Measurement, Description, Analysis, and Assessment, Biomechanics and its Relationship with Physiology and Anatomy; Signal Processing – Introduction, Auto- and Cross-Correlation Analyses, Frequency Analysis, Ensemble Averaging of Repetitive Waveforms.

Unit-II

Kinematics, Kinematic Conventions, Direct Measurement Techniques, Imaging Measurement Techniques, Processing of Raw, Kinematic Data, Calculation of Other Kinematic Variables, Problems Based on Kinematic Data; Kinetics: Forces and Moments of Force, Biomechanical Models, Basic Link-Segment Equations—the Free-Body Diagram, Force Transducers and Force Plates, Bone-on-Bone Forces During Dynamic Conditions, Problems Based on Kinetic and Kinematic Data

Unit-III

Mechanical Work, Energy, and Power – Introduction, Efficiency, Forms of Energy Storage, Calculation of Internal and External Work, Power Balances at Joints and Within Segments, Problems Based on Kinetic and Kinematic Data; Three-Dimensional Kinematics and Kinetics – Introduction, Axes Systems, Marker and Anatomical Axes Systems, Determination of Segment Angular Velocities and Accelerations, Kinetic Analysis of Reaction Forces and Moments; Synthesis of Human Movement – Introduction, Review of Forward Solution Models, Mathematical Formulation, System Energy, External Forces and Torques, Designation of Joints

Unit-IV

Muscle Mechanics – Introduction, Force-Length Characteristics of Muscles, Force-Velocity Characteristics, Muscle Modeling; Kinesiographical Electromyography – Introduction, Electrophysiology of Muscle Contraction, Recording of the Electromyogram, Processing of the Electromyogram, Relationship between Electromyogram and Biomechanical Variables. Biomechanical Movement Synergies – Introduction, the Support Moment Synergy, Medial/Lateral and Anterior/Posterior Balance in Standing, Dynamic Balance during Walking

**Recommended Books:**

- (1) Winter, Biomechanics and Motor Control of Human Movement. Wiley.
- (2) Enoka, Neuromechanics of Human Movement, Human Kinetics
- (3) Paul Grimshaw et al. Sports & Exercise Biomechanics, Taylor & Francis Group, (2007).
- (4) Peter McGinnis Biomechanics of Sport and Exercise, Human Kinetics, 2005.
- (5) Roger Bartlett, Introduction to Sports Biomechanics Analyzing Human Movement Patterns, Routledge, 2007.

MSSBM 303	Discipline Elective IV	Credit 4
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MSSBM 304	Discipline Elective V	Credit 4
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MSSBM 305	Elective I	Credit 4
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**MSSBM 306****Practicum V****Credit 2**

- Study of Movement Terminology and Joint Functions
- Measuring Joint Range of Motion of all major joints of the body
- Biomechanical Analysis of fundamental movements
- Biomechanical Analysis of Gait

- Biomechanical Analysis of Posture.
- Mechanical Analysis of Track and Field Events: Start, Running, Hurdling, Jumps and Throws
- Mechanical Analysis of fundamental skills of following games: Basketball, Volleyball, Football, Hockey, Gymnastics and Cricket

**MSSBM 307**

**Practicum VI**

**Credit 2**

- Practical to perform the test and to collect data on Force Plate
- Practical to perform the test and to collect data on dynamometer for athletes and non-athletes
- Knowledge to fix electrodes and perform test in EMG
- Practical to use Motion Analysis Software for Sports Analysis
- Biomechanical Analysis of strength training exercises
- Sports Skills or techniques has to be assessed using MATLAB

<b>MSSBM 308</b>	<b>Fitness</b>	<b>Credit 1</b>
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<b>MSSBM 309</b>	<b>Societal</b>	<b>Credit 1</b>
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#### SEMESTER-IV

<b>MSSBM 401</b>	<b>Discipline Elective VI</b>	<b>Credit 4</b>
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<b>MSSBM 402</b>	<b>Elective II</b>	<b>Credit 4</b>
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<b>MSSBM 403</b>	<b>Dissertation</b>	<b>Credit 16</b>
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<b>MSSBM 404</b>	<b>Fitness</b>	<b>Credit 1</b>
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<b>MSSBM 405</b>	<b>Societal</b>	<b>Credit 1</b>
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#### Discipline Electives

<b>S. No.</b>	<b>Title of the Course</b>
1.	<p align="center"><b>Fatigue, Injuries and Rehabilitation</b></p> <p><u>Unit-I</u> Concept of Overloading, Overtraining, Fatigue and Staleness, Symptoms and Causes of Fatigue, Types of Fatigue, Theories associated with Fatigue, Definition, Types, Symptoms, Findings, Underlying Mechanisms and Frequency of Overtraining and Overtraining Syndrome.</p> <p><u>Unit II</u> Oxygen Debt Theory, Recovery Oxygen Uptake or Excess Post-exercise Oxygen Consumption (EPOC), Implications of EPOC for Exercise and Recovery, Optimal Recovery From Steady-Rate Exercise and Non-Steady-Rate Exercise, Intermittent Exercise and Recovery</p>

	<p><u>Unit-III</u> Sports Injury- Meaning, Classification, Causes, Types, General guidelines for their Prevention, Recovery Time, Introduction and Management of common Sports Injuries (Fracture, Dislocation, Laceration, Abrasion, Sprain and Strain), How to avoid Sports Injuries, Role of Warm-up and Cool Down</p> <p><u>Unit-IV</u> Rehabilitation: Meaning, Concepts, Objective and scope of Rehabilitation, Principal of care and Rehabilitation Therapeutic Modalities: Electrotherapeutic modalities (Shortwave Diathermy, Ultra Sound, T.E.N.S), Heat and Cold, Soft tissue Massage, Aquatic Rehabilitation Exercise, Therapeutic Exercise, Therapeutic Nutrition, Psychological Rehabilitation</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Shaun Phillips (2015) Fatigue in Sport and Exercise. Routledge, NY</li> <li>(2) Therapeutic Modalities for Musculoskeletal Injuries 4th Edition, Human Kinetics by Craig Denegar, Ethan Saliba, Susan Saliba, 2016</li> <li>(3) Essentials of Athletic injury management 10th edition by William E. Prentice, Human Kinetics.</li> <li>(4) Clinical Sports Medicine Fifth Edition by Peter Brukner, Karim Khan, McGraw-Hill Education Australia, 2016</li> <li>(5) Principles and Practice of Therapeutic Massage by Sinha, Jaypee Publishers</li> <li>(6) Textbook of Electrotherapy by Singh Jagmohan, Jaypee Publishers</li> <li>(7) Manfred Lehmann, Carl Foster, Uwe Gastmann, Hans Keizer and Jtirgen M. Steinacker(Eds) (1997) Overload, Performance Incompetence and Regeneration In sport. Kluwer Academic / Plenum Publishers, N.</li> </ol>
2.	<p style="text-align: center;"><b>Essentials of Sports</b></p> <p><u>Unit-I</u> What are Play, Game and Sports? Types of sports and recreational activities, Importance of free play and organizational games, Terminology: Sports Science and Physical Education, Health Related and Motor performance Related Fitness</p> <p><u>Unit-II</u> Philosophy and its need in Sports and Physical Education, Idealism, Naturalism and Pragmatism in Physical Education, Physical Education in Ancient Greek, Rome, India and Modern India. History of Olympic Games, Asian Games, SAARC Games and SAF Games, National Sports Awards, Trends and Problems in Sports Sciences and Physical Education in 21st Century.</p> <p><u>Unit-III</u> Introduction to General Rules and Regulations of Selected Sports (Football, Field Hockey, Basketball, Volleyball, Cricket, Badminton, Tennis), Introduction to Playfields and Track Specifications, General Organizational Process of Sports Competitions.</p> <p><u>Unit-IV</u> Health and Wellness (physical, mental, psychological, social and spiritual) and Athletics, Sports Careers: Media, Management, Performance, Coaching and other Related Areas.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Bucher, C.A.: Foundation of Physical Education, St. Louis: The C.V. Mosby company, 1983.</li> <li>(2) History and Philosophy of Sport and Physical Activity, Human Kinetics by R. Scott Kretchmar, Mark Dyreson, Matthew</li> <li>(3) Liewellyn, John Gleaves, 2017. Synder and Geoh: Professional preparation in Health Education, Physical Education and Recreation.</li> <li>(4) Barrow, H.M.: Man and Movement: Principles of Physical Education, Philadelphia Lea and Fabiger, 1977.</li> <li>(5) Joseph, P.M.: Organisation of Physical Education, Kandivila,: Old students Association, T.I.P.E.</li> <li>(6) Kamlesh, M.L. and Sangral, M.S. : History and Principles of Physical Education, Prakash Brothers, 1983.</li> <li>(7) Wuest and Bucher: Foundations of Physical Education and Sports, B.I. Publications Pvt. Ltd., New Delhi.</li> <li>(8) William, H.F.: Physical Education and Sports in Changing Society, Surjeet Publication, Delhi.</li> </ol>
3.	<p style="text-align: center;"><b>Kinanthropometry</b></p> <p><u>Unit-I</u> Introduction, scope and general consideration, i.e. Application of anthropometric data in sports, Body proportions and indices, Sports specific body proportions and indices, Body mass index and its importance in sports.</p>

	<p><u>Unit-II</u> Anthropometric Measurements and Procedures, Equipment for anthropometric measurements, Gross Body Measurements and procedures, Length of Body Parts, Measurements and procedures, Diameters of Body Parts, Measurements and procedures, Circumferences of Body Parts, Measurements and procedures, Skinfold Thickness, Measurements and procedures.</p> <p><u>Unit-III</u> Physiological Maturation: Decimal Age and concept of Physiological maturity in sports. Assessment of skeletal maturity of athletes, Importance in sports and various methods to estimate body composition.</p> <p><u>Unit-IV</u> Somatotyping: Introduction, Definition of Somatotyping and Classification with special reference to sports.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Sports Anthropometry by H.S. Sodhi, ANOVA Publication.</li> <li>(2) Physique and Selection of Sportsmen by H.S. Sodhi and L.S. Sidhu.</li> <li>(3) Kinanthropometry by S.P. Singh and P. Malhotra, Luna Publication, Patiala.</li> <li>(4) Kinanthropometry by Roger Eston and Thomas Reilly, E &amp; F.N. SPON, London.</li> <li>(5) Skeletal Maturity by S.P. Singh, L.S. Sidhu, and J. Singh, Human Biology Publication Society, Punjabi University, Patiala.</li> <li>(6) Genetic and Anthropological Studies of Olympic Athletes by De Garray, Louis Levine &amp; Cater, Academic Press, London.</li> </ol>
4.	<p style="text-align: center;"><b>Health Fitness and Wellness</b></p> <p><u>Unit-I</u> Introduction to Health: Concept of health, Lifestyle and Disease, Ageing.</p> <p><u>Unit-II</u> Physical Activities &amp; Fitness: Concept to Fitness, Exercise and its Principles, Health Education Recreation &amp; Dance.</p> <p><u>Unit-III</u> Healthy Life Style Approach: Concept of Wellness, Wellbeing, Stress Management.</p> <p><u>Unit-IV</u> Spiritual and mental fitness-its concept - anxiety management and motivation.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) "Fitness and Wellness" : Warner W. K Hoeger and Sharvon A. Hoeger</li> <li>(2) "Fitness &amp; Wellness concepts": Charles B. Corbina &amp; Ruth Lindsey</li> <li>(3) "Lifetime Fitness &amp; Wellness - A personal choice": Melvin H. Williams</li> <li>(4) Oxford Textbook of Public Health, Helen Liepman.</li> <li>(5) Sunderlal, Aadarsh, Pankaj, 2007, Textbook of Community Medicine, CBS Publishers &amp; Distributors.</li> <li>(6) Kirch, Wilhelm, 2008, Encyclopedia of Public Health, Volume 1 &amp; 2, Kluwer Academic Publishers.</li> <li>(7) Mary -Jane Schneider and Henrey Schneider, 2006 (2nd edition), Introduction to Public Health, Jones and Bartlett Publishers.</li> </ol>
5.	<p style="text-align: center;"><b>Research Methodology</b></p> <p><u>Unit-I</u> Introduction to Research in Physical Activity, Developing the Problem and Using the Literature, Presenting the Problem, Formulating the Method, Ethical Issues in Research and Scholarship</p> <p><u>Unit-II</u> Types of Research: Socio Historical Process in Sport Studies, Philosophical Research in Physical Activity, Research Synthesis (Meta-Analysis), Surveys, Other Descriptive Research Methods, Physical Activity Epidemiology Research, Experimental and Quasi-Experimental Research, Qualitative Research, Mixed-Methods Research</p> <p><u>Unit-III</u> Writing the Research Report: Completing the Research Process, Ways of Reporting Research, Introduction to review of literature, Evaluation of scientific literature; Tools of research- Questionnaires, opinionnaires, interviews and</p>

	<p>observation. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response</p> <p><u>Unit-IV</u> Organizing literature – strategies, use of software; Metaanalysis, Writing review – structuring the review, quoting/paraphrasing, the citation referencing system. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Research Methodology: Methods and Techniques by C. R. Kothari.</li> <li>(2) ICMR. Ethical Guidelines for Biomedical Research on Human Subjects. 2006; ICMR, New Delhi.</li> <li>(3) Research Methods in Physical Activity- 7th Edition By Jerry Thomas, Jack Nelson, Stephen Silverman, Human Kinetics</li> <li>(4) Research Methods in Sport by Mark F Smith.</li> <li>(5) Research Methods for Sports Performance Analysis By Peter O' Donoghue.</li> <li>(6) Research Methods in Physical Education and Youth Sport 1st Edition by Kathleen Armour and Doune Macdonald.</li> <li>(7) Ridley, D. The Literature Review a step-by-step guide for students. 2012; Sage Publications Limited, New Delhi.</li> </ol>
6.	<p style="text-align: center;"><b>Instrumentation and Techniques in Biomechanics</b></p> <p><u>Unit-I</u> Cinematography and video analysis: The use of cine and video analysis in sports biomechanics Introduction, Levels of biomechanical analysis of sports movements, Recording the movement, Recording the image: cameras and lenses, Displaying the image: cine projectors and video players, Obtaining body coordinates and its analysis, Problems and sources of error in motion recording, Experimental procedures: Two-dimensional recording procedures, Three-dimensional recording procedures, Data processing, Body segment inertia parameters, Segment orientations, Introduction to motion analysis software (2D &amp; 3D) and their procedures and applications.</p> <p><u>Unit-II</u> Instruments for Sports Analysis and their applications: Radar Gun, Doppler radar device, Speedometer, Accelerometer, Force gauge, Spring scale, Dynamometer, Goniometer. Measurement of force by force platform, force plate, podometric platform. Introduction and equipment considerations, General equipment considerations, The detector-transducer, Signal conditioning and recording, Operational characteristics of a force platform system Experimental procedures, Calibration, Data processing, Examples of the use of force measurement in sports biomechanics.</p> <p><u>Unit-III</u> Electromyography - Introduction, Experimental considerations, Recording the myoelectric (EMG) signal EMG electrodes, Cables, EMG amplifiers, Recorders, Experimental procedures, Data processing, Temporal processing and amplitude analysis (time domain analysis), Frequency domain analysis, EMG and muscle tension, Isometric contractions, Non-isometric contractions</p> <p><u>Unit-IV</u> Other techniques for the analysis of sports movements - Single-plate photography, Automatic tracking optoelectronic systems, Measurement of muscle force and torque, Direct measurement of muscle force, Isokinetic dynamometry</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Paul Grimshaw et al. Sports &amp; Exercise Biomechanics, Taylor &amp; Francis Group, (2007).</li> <li>(2) Susan J. Hall, Basic Biomechanics, McGraw Hill Education, 2004.</li> <li>(3) Peter McGinnis Biomechanics of Sport and Exercise, Human Kinetics, 2005.</li> <li>(4) Kathryn Lutgens et al. Kinesiology (Scientific Basis of Human Motion), Brown and Bench mark, 1992.</li> <li>(5) Roger Bartlett, Introduction to Sports Biomechanics Analyzing Human Movement Patterns, Routledge, 2007.</li> <li>(6) Knudson, Duane V. Fundamentals of Biomechanics, Springer, 2007</li> </ol>
7.	<p style="text-align: center;"><b>MATLAB</b></p> <p><u>Unit-I</u> Desktop basics, Matrices and arrays, Workspace variables, Character strings, Calling function, Plots and programming scripts. Language fundamentals, Matrices and magic squares, Expressions, Entering commands, indexing and types of arrays</p>

	<p>Unit-II Mathematics: Linear algebra, Operations on nonlinear functions, Multivariate data and Data analysis</p> <p>Unit-III Graphics: Basic plotting function, Creating mesh and surface plots, Display images, Printing graphics, Working with graphic objects.</p> <p>Unit-IV Programming: Control flow, Scripts and function</p> <p><b>Recommended Books:</b> (1) Krister Ahlersten, An Introduction to Matlab (2) Brian Hahn and Dan Valentine, Essential MATLAB for Engineers and Scientists (Fifth Edition) (3) Stormy Attaway, Matlab: A Practical Introduction to Programming and Problem Solving 3rd Edition</p>
8.	<p style="text-align: center;"><b>Biomechanics of Yoga Asanas</b></p> <p>Unit-I Yogic principles in stretching: Active vs. passive range of motion, Performance and injury, Stretch tolerance, Muscle physiology, Stretching techniques, Proprioceptive Neuromuscular Facilitation (PNF), Reciprocal inhibition and autogenic inhibition, Eccentrics, Connective tissue histology, Stress, strain, and time dependent outcomes</p> <p>Unit-II The role of foot flexibility in standing postures, The knee as a bicondylar joint, Spinal evolution and triplanar movement, Dissecting the tree pose debate (vrksasana), Pigeon pose with a purpose (eka pada raja kapotasana), Breathing practices that set up your students for success, How mental imagery can alter the body, Strengthen to lengthen, Proprioception and interoception, Importance of variability, Introduction to motor control theories</p> <p>Unit-III Yoga for recovering certain conditions using Biomechanics principles: Osteoarthritis, Shoulder impingement syndrome, Bicep tendonitis, Femoral acetabular impingement syndrome, Labral and meniscus tears, Proximal hamstring, Tendinopathy, Gluteus maximus activation patterns, Patellofemoral syndrome, Plantar fasciitis</p> <p>Unit-IV Hypermobility and Yoga: Common symptomatology in hypermobile individuals, Skills and techniques to maintain joint integrity and tissue health, Analysis of forward, backward, prone, supine and balancing postures and the best ways to approach them with hypermobility</p> <p>Unit-V Mobility based conditioning: Core Intelligence™ practices, Scapular Intelligence™ practices, Lower extremity drills, Advanced core progressions, Upper extremity drills – pulling, pushing, handstands, Bonus course – Spinal Intelligence™ and bridge progressions</p> <p><b>Recommended Books:</b> (1) Francoise et al. Yoga and Pilates for everyone, Joanna lawrenz, 2006</p>
9.	<p style="text-align: center;"><b>Biomechanical Applications in Sports Training</b></p> <p>Unit-I Physiological Adaptations to Anaerobic Training, Muscular - Hypertrophy and Force Production, Energy Production Capacity of the Muscle and Specific Fiber Type Adaptations.</p> <p>Unit II Resistance Training and Spotting Techniques – Equipment: Body Weight Exercises, Free Weights, Variable Resistance Machines, Isokinetic Equipment; Exercise and Spotting – Technique, Upper Body Exercises, Lower Body Exercises, Explosive Lifts</p> <p>Unit-III Resistance Training Programming for General Fitness - Exercise Selection, Training Intensity and Frequency, Special Populations; Resistance Training Programming for Performance Enhancement - Training Protocol, Exercise Selection, Training Intensity and Frequency, Periodization.</p> <p>Unit-IV</p>



	<p>Training for Power, Speed, and Agility - Plyometric Training, Speed Training, Agility Training. Biomechanics of Resistance Exercise, video of an athletic activity, complete analyse the exercise, identify the muscles involved, determine the types of contraction, determine the range of motion with respect to plane, determine the intensity, estimate the velocity from the start to end of the exercise, make sure the exercise performed are appropriate.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Baechle TR, Earle RW. Essentials of Strength Training and Conditioning (3rd edition) Champaign, Human Kinetics 2008</li> <li>(2) Paul Grimshaw et al. Sports &amp; Exercise Biomechanics, Taylor &amp; Francis Group, (2007).</li> </ol>
10.	<p style="text-align: center;"><b>Application of Gross Anatomy in Sports</b></p> <p><b>Unit-I</b>  The Shoulder Complex - Anatomical and Functional, Characteristics of the Joints of the Shoulder, Combined Movement Characteristics of the Shoulder Complex, Muscular Actions Strength of the Shoulder Muscles Conditioning, Injury Potential of the Shoulder Complex; The Elbow and Radioulnar Joints - Anatomical and Functional, Characteristics of the Joints of the Elbow, Muscular Actions, Strength of the Forearm Muscles Conditioning, Injury Potential of the Forearm; The Wrist and Fingers - Anatomical and Functional, Characteristics of the Joints of the Wrist and Hand, Combined Movements of the Wrist and Hand, Muscular Actions, Strength of the Hand and Fingers Conditioning, Injury Potential of the Hand and Fingers; Contribution of Upper Extremity Musculature to Sports Skills or Movements - Overhand Throwing, The Golf Swing; External Forces and Moments Acting at Joints in the Upper Extremity</p> <p><b>Unit-II</b>  The Pelvis and Hip Complex - Pelvic Girdle, Hip Joint, Combined Movements of the Pelvis and Thigh, Muscular Actions, Strength of the Hip Joint Muscles, Conditioning of the Hip Joint Muscles, Injury Potential of the Pelvic and Hip Complex; The Knee Joint - Tibiofemoral Joint, Patellofemoral Joint, Tibiofibular Joint, Movement Characteristics, Muscular Actions, Combined Movements of the Hip and Knee, Strength of the Knee Joint Muscles, Conditioning of the Knee Joint Muscles, Injury Potential of the Knee Joint. Cycling; Forces Acting on Joints in the Lower Extremity - Hip &amp; Knee Joint</p> <p><b>Unit-III</b>  The Ankle and Foot - Talocrural Joint, Subtalar Joint, Midtarsal Joint, Other Articulations of the Foot, Arches of the Foot, Movement Characteristics, Combined Movements of the Knee and Ankle/Subtalar, Alignment and Foot Function, Muscle Actions, Strength of the Ankle and Foot Muscles, Conditioning of the Foot and Ankle Muscles, Injury Potential of the Ankle and Foot; Contribution of Lower Extremity Musculature to Sports Skills or Movements - Stair Ascent and Descent, Locomotion, Cycling; Forces Acting on Joints in the Lower Extremity - Ankle and Foot</p> <p><b>Unit -IV</b>  The Vertebral Column - Motion Segment: Anterior Portion, Motion Segment: Posterior Portion, Structural and Movement Characteristics of Each Spinal Region, Movement Characteristics of the Total Spine, Combined Movements of the Pelvis and Trunk; Muscular Actions - Trunk Extension, Trunk Flexion, Trunk Lateral Flexion, Trunk Rotation; Strength of the Trunk Muscles Posture and Spinal Stabilization - Spinal Stabilization, Posture, Postural Deviations; Conditioning - Trunk Flexors, Trunk Extensors, Trunk Rotators and Lateral Flexors, Flexibility and the Trunk Muscles, Core Training; Injury Potential of the Trunk; Effects of Aging on the Trunk; Contribution of the Trunk Musculature to Sports Skills or Movements; Forces Acting at Joints in the Trunk</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Joseph Hamill, Kathleen M. Knutzen, Timothy R. Derrick, (2015). Biomechanical Basis of Human Movement (4th edition); Lippincott Williams &amp; Wilkins, Philadelphia, USA</li> <li>(2) Paul Grimshaw et al. Sports &amp; Exercise Biomechanics, Taylor &amp; Francis Group, (2007).</li> <li>(3) Peter McGinnis Biomechanics of Sport and Exercise, Human Kinetics, 2005.</li> <li>(4) Roger Bartlett, Introduction to Sports Biomechanics Analyzing Human Movement Patterns, Routledge, 2007.</li> </ol>
11.	<p style="text-align: center;"><b>Instrumentation and Techniques in Biomechanics</b></p> <p><b>Unit-I</b>  Cinematography and video analysis: The use of cine and video analysis in sports biomechanics Introduction, Levels of biomechanical analysis of sports movements, Recording the movement, Recording the image: cameras and lenses, Displaying the image: cine projectors and video players, Obtaining body coordinates and its analysis, Problems and sources of error in motion recording, Experimental procedures: Two-dimensional recording procedures, Three-dimensional recording procedures, Data processing, Body segment inertia parameters, Segment orientations, Introduction to motion analysis software (2D &amp; 3D) and their procedures and applications.</p>

	<p>Unit-II Instruments for Sports Analysis and their applications: Radar Gun, Doppler radar device, Speedometer, Accelerometer, Force gauge, Spring scale, Dynamometer, Goniometer. Measurement of force by force platform, force plate, podometric platform. Introduction and equipment considerations, General equipment considerations, The detector-transducer, Signal conditioning and recording, Operational characteristics of a force platform system Experimental procedures, Calibration, Data processing, Examples of the use of force measurement in sports biomechanics.</p> <p>Unit-III Electromyography - Introduction, Experimental considerations, Recording the myoelectric (EMG) signal EMG electrodes, Cables, EMG amplifiers, Recorders, Experimental procedures, Data processing, Temporal processing and amplitude analysis (time domain analysis), Frequency domain analysis, EMG and muscle tension, Isometric contractions, Non-isometric contractions</p> <p>Unit-IV Other techniques for the analysis of sports movements - Single-plate photography, Automatic tracking optoelectronic systems, Measurement of muscle force and torque, Direct measurement of muscle force, Isokinetic dynamometry</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Paul Grimshaw et al. Sports &amp; Exercise Biomechanics, Taylor &amp; Francis Group, (2007).</li> <li>(2) Susan J. Hall, Basic Biomechanics, McGraw Hill Education, 2004.</li> <li>(3) Peter McGinnis Biomechanics of Sport and Exercise, Human Kinetics, 2005.</li> <li>(4) Kathryn Lutgens et al. Kinesiology (Scientific Basis of Human Motion), Brown and Bench mark, 1992.</li> <li>(5) Roger Bartlett, Introduction to Sports Biomechanics Analyzing Human Movement Patterns, Routledge, 2007.</li> <li>(6) Knudson, Duane V. Fundamentals of Biomechanics, Springer, 2007</li> </ol>
12.	<p style="text-align: center;"><b>Biomechanical Analysis of Athletics and Team Games</b></p> <p>Unit-I History, legends, world record, skills, technique, application of biomechanical principles and analysis, 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 Middle and Long Distance and Relays (800m, 1500m, 5000m, 10000m , and 4x100m and 4x400m) Track events (Sprint - 100m, 200m and 400m) Hurdles (100m, 110m and 400m hurdles) Hurdles – High hurdles-Approach-take-off-Flight-Landing- Running between hurdles-Intermediate hurdles-Low hurdles</p> <p>Unit-II Throws (Shot-put, hammer, discus and javelin) technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance. Shot-put - Shot-put - O'Brien style-Initial stance-Glide-Delivery-Reverse - Rotation style- distance prior to release Physique-Position-Distance after release-Height of release-Speed of release-Forces exerted -Angle of release – Air resistance - Advantages and Disadvantages of O'Brien and Rotation techniques. Hammer - Hammer Throw – Preliminary swing-The first turn-The second turn-The third turn-The delivery-Air resistance Speed of releaseAngle of release-Height of release. Discus - Discus Throw – Initial stance –Preliminary swings-Transition-TurnDelivery-reverse-Aerodynamic factors. Javelin- Javelin Throw – Types of Grip –Carry- Run – Transition, Throw, and Recovery-Speed, Angle, Height of release- Aerodynamic factors influencing flight- Advantages and Disadvantages of different Grips-Aerodynamic Javelin.</p> <p>Unit-III Jumps (Long jump, Triple jump, High jump and Pole vault) technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance. Long Jump-Hang style - Hitch Kick style - Approach run – Take-off -Flight in the Air - Landing – Take-off distance-Flight distance-Speed, angle, height of take off-air resistance-Advantages and Disadvantages of different styles. Triple Jump - Hop - Step and Jump- Approach Run – Take-off - Flight in the Air – Landing</p> <p>Unit IV Basketball, Volleyball, Badminton, hockey, football, cricket, boxing, gymnastics, cycling and swimming - History of the game, skills and technique, application of biomechanical principles, analysis of skills related each games and sports.</p> <p><b>Recommended Books:</b></p> <ol style="list-style-type: none"> <li>(1) Hay, J. (1993). The Biomechanics of Sports Techniques, Benjamin Cummings.</li> <li>(2) McGinnis, Peter M. Biomechanics of Sport and Exercise, Human Kinetics, 2005.</li> </ol>

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

13.

### **Biomechanical Analysis of Human Movements.**

#### **Learning Outcome:**

- Develop an Understanding of Various type of Analysis and their application
- Able to demonstrate and apply basic mechanical and physics principles to human movements
- Gain the ability to describe the fundamental movement in relation with mechanics and justify the efficiency of it.

#### Unit-I

#### **1. Methods of Analysis Human Movement**

##### 1.1 Qualitative Analysis

- 1.1.1 Pre Requisite Information
- 1.1.2 Basic Step of Observation Method
- 1.1.3 Identification of Faults

##### 1.2 Quantitative Analysis

- 1.2.1 Creation of Model
- 1.2.2 Video Recording with Accuracy
- 1.2.3 Vertex Digitization
- 1.2.4 Draw Trajectory of Vertex
- 1.2.5 Stick Figure

##### 1.3 Predictive Analysis

#### Unit-II

#### **2. Mechanical Analysis of Locomotion**

- 2.1 Walking
- 2.2 Running
- 2.3 Jumping
- 2.4 Hopping or Leaping

#### Unit-III

#### **3. Mechanical Analysis of giving motion to external objects in everyday tasks and sports**

- 3.1 Pulling
- 3.2 Throwing
- 3.3 Hitting
- 3.4 Kicking
- 3.5 Stroking

#### Unit-IV

#### **4. Qualitative Biomechanical Analysis to Improve training**

- 4.1 Temporal Phase, Joint Motion
- 4.2 Identification of Predominant active muscle (Each Joint)
- 4.3 Identification of Angular Kinematics and Impacts
- 4.4 Biomechanical Analysis to understand Injury Development –Wolffs Law

#### **Recommended Books:**

- (1) Efficiency of Human Movement by marrion Brore, W.B saundens company
- (2) Analysis of Human motion a textetbook in Kinesiology. M. Gladys scott. Appleton-century-crofts Inc., N.York.
- (3) Sports Biomechanics, Reducing injury and Improving performance, roger Battlett, Taylor and Francis, London and N.York
- (4) Kinesiology Scientific Basis of Human Motion K. Lutthens and K.F Wells., Saundens College publishing, N.York.

14.

### Statistics for Sports Science

#### Unit-I

Introduction to Biostatistics, Frequency Distribution, Variable and Attribute, Line-diagram, Bar-diagram, Pie chart, Histogram, Mean, Median and Mode. Data, its types and collecting measures. Statistical processes, their importance and uses in research.

#### Unit-II

Variance, Standard deviation; Standard error of mean, Null hypothesis, Level of significance and Probability; Regression and correlation. Normal probability curve and grading scales. Sampling Techniques- Probability and non-probability. Reliability and validity test.

#### Unit-III

Student's t-test, Fisher's t-test, Chi-square test, Analysis of Variance (ANOVA), ANCOVA, Mann whitney U test , test of concordance and Krushal wailles test. Application of parametric and non-parametric statistical techniques in research.

#### Unit-IV

Introduction and Application of Statistical Software. Computer applications- statistical packages for data analyses- SPSS, e-mail, search engines and Microsoft office.

#### **Recommended Books:**

1. A Text book of Biostatistics, by A.K.Sharma, Discovery publishing house
2. Introduction to Biostatistics, By Dr. Pranab Kumar Banerjee, S. Chand Publishers
3. Research Methodology: Methods and Techniques Book by C. R. Kothari Dutta N.K.
4. Fundamentals of Bio-Statistics. 2002; Kanishka Publishers, New Delhi. Gupta S.P.
5. Statistical Methods. 2004; S. Chand & Sons, New Delhi. Ruud H. Koning and James H. Albert ( 2008) S
6. Statistical thinking in sports. Chapman & Hall/CRC.

- Any other Elective Courses introduced from time to time will be included in the Discipline Elective (DE) of the M.Sc. Programme.