

# **Department of Sports Biomechanics**

## **SYLLABUS M.A. (Sports Biomechanics)**

**(Under Credit Based Continuous Evaluation Grading System)**



**Rajiv Gandhi University**  
**Rono Hills :: Doimukh**

*(Approved by the Ministry of Youth Affairs and Sports Government of India)*

Note:

1. Copyrights are reserved.
2. Nobody is allowed to print it in any form. Defaulters will be prosecuted.
3. Subject to change in the syllabi at any time. Please visit the University website time to time.

## **DEPARTMENT OF SPORTS BIOMECHANICS**

### **M.Sc. SPORTS BIOMECHANICS**

#### **REGULATIONS AND SYLLABUS**

(For students admitted from academic year 2021-22)

#### **1. Objectives:**

The M.Sc. Sports Biomechanics course is designed to provide an opportunity to students to apply theory to practice, which creates a highly valuable learning experience with clear vocational and professional significance. The content on M.Sc. Sports Biomechanics has been carefully designed to provide quality assured professional training to meet the needs of the athletes and to foster life-long learning in participants.

This programme is designed to:

- Develop knowledge and understanding of the principles and applications of sport and exercise biomechanics and their application to vocational/professional practice.
- Provide an opportunity to critically assess a broad range of theories, methodologies and research findings in sport and exercise biomechanics.
- Develop a critical understanding of how to apply theories, strategies and methodologies in appropriate ways.
- Enable the student to develop empirical rigour in identifying solutions to complex problems.
- Develop the appreciation of inter-related scientific concepts that promote understanding of problems and issues in the study of sport and exercise biomechanics.
- Provide a forum for the development of research skills and professional competencies in the field of sport and exercise biomechanics.

#### **2. International Universities:**

The syllabus of following was consented for preparing final draft of M.Sc. Sports Biomechanics.

1. Loumbourg University, United Kingdom
2. RMIT University, Australia (Royal Melbourne Institute of Technology)
3. Sports University, Germany

#### **3. Definition of key words:**

- Programme: An educational program leading to the award of a Degree, diploma or certificate.
- Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

- **Semester:** Each semester consists of 15-18 weeks of academic work equivalent to 90 days of actual teaching days. The odd semester may be scheduled from July to December and even Semester from January to June.
- **CBCS (Choice Based Credit System):** It provides choice for students to select from the prescribed courses.
- **Course:** It is usually referred to as “Papers”. All courses need not carry the same weight. A course may comprise lectures/tutorials/laboratory, work/field, work/outreach activities/project work/vocational training/viva/seminars etc or a combination of some of these.
- **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.
- **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.
- **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. Elective papers can be of two types: Discipline Specific Elective (DSE) and Generic Elective (GE). Core / DS Electives will not be offered as Generic Electives. Elective papers can be taken from MOOC courses and credit transfer should be allowed.
- Each of the Core courses and Discipline Specific Elective (DSE) shall be of 4 credits. Credits under DSE may vary (16/12/8) depending upon the number of DSE courses offered across the semesters.
- **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.
- **Generic Elective (GE):** These courses add generic proficiency to the students. Students have to choose generic elective courses in consultation with the head of the department from the Generic Elective courses offered by other Division of study in Sports Science or from other Departments in university.

#### 4. Course Structure:

This **M.Sc. Sports Biomechanics** is a programme consists of core courses, soft core courses, practical courses, internship and project work. The entire programme carries credit system. The number and distribution of credits for the programme will be decided by therespective faculties.

A programme is divided into two Semesters, Odd Semester and Even Semester. The normal Semester periods are:

Odd Semester: July to November (90 Working days)

Even Semester: December to April (90 Working days)

## **5. Credits:**

The term credit is used to describe the quantum of syllabus for various courses in terms and hours of study. It indicates differential weight age given according to the contents and duration of the courses in the curriculum design. The minimum credit requirement for a two years Master's Programme shall be 90.

One credit of theory equals one lecture hour and

One credit of practical equals two laboratory or field hours.

## **6. Courses:**

Each Programme may consist of Lectures / Tutorials / Laboratory Work / Seminar / Project Work/ Practical Training Report / Viva-Voce etc. Normally, in each of the programmes, credits will be assigned on the basis of the Lectures/Tutorials/Laboratory Work and other form of learning in a 18 week schedule.

## **7. Eligibility for Admission:**

A candidate who has passed Bachelor's Degree in Sports Sciences / Physical Education and Sports / Physics with Mathematics / Physiotherapy / Engineering (Computer Science / E&I / IT/ Biomedical) from a recognized university with a minimum of 50% marks in aggregate.

## **8. Grading System:**

The term grading system indicates a 10 point scale of evaluation of the performance of students in terms of marks, grade points, letter grade and class.

## **9. Duration:**

The duration for completion of Two Years Master's programme in any subject is four Semesters, But in any case not more than five years from the year of admission.

## **10. Attendance:**

Every teaching faculty handling a course shall be responsible for the maintenance of Attendance Register for candidates who have registered for the course.

The instructor of the course must intimate the Head of the Department at least Seven Calendar Days before the last instruction day in the semester about the particulars of all students who have

secured an attendance of less than 80%.

A candidate who has attendance less than 80% shall not be permitted to sit for the end–semester examination in the course in which the shortage exists.

However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 80% attendance for valid reasons on payment of a condonation fee and such exemptions should not under any circumstances be granted for attendance below 70%.

## 11. Examination:

There will be two sessional assessment tests and one End–Semester examination during each semester.

Sessional Test–I will be conducted after 35 working days and Sessional Test–II will be conducted after 70 working days.

Sessional Test–I will be a combination of a variety of tools such as class test, assignment and paper presentation that would be suitable to the course. This requires an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However, the tests are compulsory. Test–I may be for one hour duration. The pattern of question paper will be decided to the respective faculty. Sessional Test–I will carry 12.5% of marks of the entire course.

Sessional Test–II will be held after 70 working days for the syllabi covered between Seventh and Eleventh weeks.

Sessional Test–II will be conducted with a variety of assessment tools. It will also have an element of openness. The students are to be informed in advance about the nature of assessment and the procedures. However, the tests are compulsory. Test–II may be for two hours duration. The pattern of question paper will be decided by the respective Faculty. Sessional Test–II carries 12.5% of marks of the entire course.

There will be one End–Semester Examination of 3 Hours’ duration in each course. The end Semester examination will cover all the syllabus of the course for 75% of marks.

Each course shall carry a maximum of 100 marks for the purpose of grading. The distribution of marks shall be as follows.

Theory Marks			Practical Marks		
Internal	External	Maximum	Internal	External	Maximum
40	60	100	40	60	100

**12. Project Field work:**

The project field work shall carry 100 marks and shall be evaluated through internal assessment only. At the end of Internship / Practical training / Summer Project, the candidate shall submit a certificate from the organization where he /she have undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department. Certificates (issued by the training centre or Organization) submitted by the candidate shall be attached to the mark list sent by the Head of the Department.

**13. Evaluation and Grading:**

Evaluation and grading will be done based on university rules.

**14. Withdrawal from the course by the student:**

Within two weeks from the date of commencement of the semester.

## PROPOSED SCHEME OF EXAMINATION

<b>M.Sc. Sports Biomechanics: Two-Year (4-Semester) CBCS Programme</b>								
<b>Programme Structure</b>								
<b>Semester – I</b>								
Course Code	Course Title	Course Type	Total Credit	No. of Credit hours			Marks Split	
				L	T	P	Int.	Ext.
SBI-511 (C)	Introduction to sports Biomechanics	Core	4	4	-	0	40	60
SBI-512(C)	Functional Anatomy	Core	4	4	-	0	40	60
SBI-513(C)	Research Methodology and Applied Statistics	Core	4	4	-	0	40	60
SBI-514 (E)	Generic Elective any <i>one</i> a. Athletic Care ofathletic Injury b. Sports Training	Elective	3	3	-	-	40	60
SBI-515 (P)	Practical – I (Introduction to sports Biomechanics)	Practical	2	-	-	04	40	60
SBI-516(P)	Practical – II (Functional Anatomy)	Practical	3	-	-	06	40	60
SBI-517(P)	Practical - III (Research Methodology andApplied Statistics)	Practical	3	-	-	06	40	60
SBI-518(P)	Practical - IV (Exposure to concerned sports)	Practical	4	-	-	8	50	-
<b>Total</b>			<b>27</b>	<b>15</b>	<b>-</b>	<b>24</b>	<b>330</b>	<b>420</b>

M.Sc. Sports Biomechanics: Two-Year (4-Semester) CBCS Programme								
Programme Structure								
Semester – II								
Course Code	Course Title	Course Type	Total Credits	No. of Credit hours			Marks Split	
				L	T	P	Int	Ext
SBI-521(C)	Fundamental of movement analysis	Core	4	4	-	0	40	60
SBI-522(C)	Instrument for recording and analyzing sports movement	Core	4	4	-	0	40	60
SBI-523(C)	Kinanthropometry	Core	4	4	-	0	40	60
SBI-524(E)	Discipline Specific Elective Any one a. Methods in Neuromechanics b. Biomechanics of Sports Injury	Elective	3	3	-	0	40	60
SBI-525(E)	<i>Generic Elective</i> Physics in Sports (other department students)	Elective						
SBI-526 (P)	Practical – V (Fundamental of movement analysis)	Practical	2	-	-	4	40	60
SBI-527 (P)	Practical – VI (Instrument for recording and analyzing sports movement)	Practical	3	-	-	6	40	60
SBI-528 (P)	Practical – VII (Kinanthropometry)	Practical	3	-	-	6	40	60
SBI-529 (P)	Practical - VIII (Exposure to concerned sports)	Practical	4	-	-	8	50	-
<b>Total</b>			<b>27</b>	<b>15</b>	<b>-</b>	<b>24</b>	<b>330</b>	<b>420</b>



M.Sc. Sports Biomechanics: Two-Year (4-Semester) CBCS Programme								
Programme Structure								
Semester – III								
Course Code	Course Title	Course Type	Total Credits	No. of Credit hours			Marks Split	
				L	T	P	Int	Ext
SBI-531 (C)	Dynamics of Gait	Core	4	4	-	0	40	60
SBI-532 (C)	Performance Analysis	Core	4	4	-	0	40	60
SBI-533 (C)	Biomechanical analysis of human movement	Core	4	4	-	0	40	60
SBI-534 (E)	Discipline Specific Elective Any one a. Strength and conditioning and application of biomechanics b. Motor control in sports	Elective	3	3	-	-	40	60
SBI-535 (E)	Generic Elective any one a. Exercise physiology b. Yogic Science	Elective	3	3	-	0	40	60
SBI-536 (P)	Practical – IX (Dynamics of Gait)	Practical	2	-	-	12	40	60
SBI-537 (P)	Practical – X (Performance Analysis)	Practical	2	-	-	12	40	60
SBI-538 (P)	Practical – XI (Biomechanical analysis of human movement)	Practical	2	-	-	12	40	60
SBI-539 (P)	Practical – XII (MATLAB)	Practical	4	4	-	12	40	60
<b>Total</b>			<b>26</b>	<b>21</b>	<b>-</b>	<b>16</b>	<b>360</b>	<b>540</b>

<b>M.Sc. Sports Biomechanics: Two-Year (4-Semester) CBCS Programme</b>								
<b>Programme Structure</b>								
<b>Semester – IV</b>								
<b>Course Code</b>	<b>Course Title</b>	<b>Course Type</b>	<b>Total Credits</b>	<b>No. of Credit hours</b>			<b>Marks Split</b>	
				<b>L</b>	<b>T</b>	<b>P</b>	<b>Int</b>	<b>Ext</b>
SBI-541(C)	Biomechanical Analysis of Sports Skills	Core	4	4	-	0	40	60
SBI-542(C)	Application of Biomechanics to Physiological Systems	Core	4	4	-	0	40	60
SBI-543(C)	Clinical Biomechanics	Core	4	4	-	0	40	60
SBI-543(C)	Dissertation	Core	8	-	-	16	40	60
SBI-543(P)	Project Field work	Practical	2	-	-	4	50	-
<b>Total</b>			<b>22</b>	<b>12</b>	<b>-</b>	<b>20</b>	<b>210</b>	<b>240</b>

## M.Sc. Sports Biomechanics

### CUMULATIVE CHART

<b>Semester</b>	<b>Credit</b>	<b>Internal Mark</b>	<b>External Mark</b>	<b>Total</b>
<b>I</b>	27	330	420	750
<b>II</b>	27	330	420	750
<b>III</b>	30	360	540	900
<b>IV</b>	22	210	240	450
<b>Grand Total</b>	<b>106</b>	<b>1230</b>	<b>1620</b>	<b>2850</b>

<b>Percentage of Theory hours per semester</b>	<b>Percentage of practical hours per semester</b>
<b>39.47%</b>	<b>60.52%</b>

# Semester – I

## SBI-511 (C) Introduction to Sports Biomechanics

### Learning Objective:

- Know the concept and purpose of Biomechanics
- Able to differentiate Kinematic and Kinetic Parameters
- Knowledge about basic mechanics applied in sports

### UNIT-I

#### **1. Introduction of Fundamentals of Biomechanics**

##### **1.1. Definition of Biomechanics & Sports Biomechanics**

##### **1.2. Importance of Biomechanics for Physical Education Teacher, Coach & Athlete**

##### **1.3. Goals of Sports Biomechanics – Performance Enhancement, Technique, Equipment, Training, Injury Prevention and Rehabilitation**

##### **1.4. Elementary Trigonometry**

##### **1.5. Definition of Trigonometry**

##### **1.6. Pythagoras Theorem**

##### **1.7. Trigonometric Ratios in right triangles**

##### **1.8. Problems related to skill**

### **Unit – II**

#### **2. Linear and Angular Kinematics**

##### **2.1 Linear Kinematic**

##### **2.1.1. Quantities: Distance and Displacement**

##### **2.1.2. Speed, Velocity, and Acceleration**

##### **2.1.3. Vectors and Scalars**

##### **2.1.4. Units**

##### **2.2 Angular Kinematics**

##### **2.2.1. Angular Distance and Displacement**

##### **2.2.2. Angular Speed and Velocity**

##### **2.2.3. Units in angular kinematics**

##### **2.2.4. Angular Acceleration**

### **Unit – III**

#### **3. Linear Kinetics**

##### **3.1.1 Inertia**

##### **3.1.2. Mass**

##### **3.1.3. Force (Internal and External)**

##### **3.1.4. Momentum**

##### **3.1.5. Friction and its types**

##### **3.1.6. Pressure**

## **3.2 Angular Kinetics of Human Movement:**

### **3.2.1. Eccentric force**

### **3.2.2. Couple**

### **3.2.3. Moment of force**

### **3.2.4. Moment of Inertia**

### **3.2.5. Center of gravity and its uses**

## **Unit – IV**

### **4. Motion**

#### **4.1 Basic Concept: Forms of Motion**

#### **4.2 Linear Motion**

#### **4.3 Angular Motion**

#### **4.4 General Motion**

#### **4.5 Concept of Relative Motion**

#### **4.6 Newton's Law of Linear Motion**

## **References**

1. Bunn, John W. **Scientific Principles of Coaching**, Second Edition. (Englewood cliffs, New Jersey : Prentice Hall, Inc. 1972)
2. Hall, Susan J. **Basic Biomechanics**, Fourth Edition (Boston etc. : WCB/MC Graw-Hill Companies, 2004)
3. Hay, James G. **The Biomechanics of Sports Techniques**, Fourth Edition (Englewood cliffs, New Jersey; Prentice Hall, 1993)
4. Hay, James G. and Reid J. Gavin, **Anatomy, Mechanics and Human motion**, Second Edition (Englewood cliffs, New Jersey: Prentice Hall, 1988).
5. Kreighbaum, Ellen and Barthels. **Biomechanics – A qualitative Approach for studying Human movement**. Third edition (New York : MC millan publishing company, 1990)
6. Mc. Ginnis, Peter M. **Biomechanics of Sport and Exercise**, Second Edition (Champaign: Human kinetics publishers, 2005)
7. Rai Ramesh, **Biomechanics – Mechanical Aspects of human motion** (Mohali Punjab : Agrim Publication, 2003)
8. Robertson, D. Gordon E. et. Al. **Research Methods in Biomechanics**. (Champaign etc : Human kinetics publishers, 2004)

## **Practical – I**

### **Introduction to sports Biomechanics: SBI-515 (P)**

1. Manual calculations of various kinetic and kinematic parameters – distance, displacement, speed, velocity, acceleration, momentum, force, mass, weight, resultant vector, pressure, work, power, energy etc.
2. Stick diagram (basic techniques; anatomical posture, walking, push up, sit ups etc.)
3. Goniometry – measurement of joint ROM / Elgon
4. Basic anthropometric measurements (stature, sitting height, different body segment length, weight, BMI and skin fold measurements)

### **SBI-512(C) FUNCTIONAL ANATOMY**

#### **Learning Objectives:**

1. To study about muscles, joints and bones associated with shoulder, wrist, fingers, hip, ankle, foot, and vertebral column and their role on movements
2. To study about the contribution of upper and lower extremity musculature to sports skills
3. To study about the forces acting at joints to enhance sports performance

#### **Learning Outcomes:**

1. Understand the scaplohumeral rhythm in an arm movement
2. Identify the muscular actions contributing to shoulder, wrist, fingers, hip, ankle, foot and vertebral column
3. Alterations in the alignment in the upper and lower extremities on sports performance
4. Understand the movement relationship between the pelvis and the lumbar vertebrae for the full range of trunk movement
5. Understand the importance of strength and flexibility of the muscles to perform actions without injury

#### **UNIT 1**

##### **1.1 The Upper extremities - Anatomical and Functional**

##### **1.2. Characteristics of the Joints of the Shoulder, elbow, wrist**

##### **1.3. Combined Movement Characteristics of the Shoulder, elbow, wrist**

##### **1.4. Muscular Actions Strength of the Shoulder, elbow, and wrist**

##### **1.5. Muscles Conditioning**

##### **1.6. Injury Potential of the Shoulder, elbow and wrist**

#### **UNIT 2**

##### **2.1. The Pelvis and Hip Joint - Pelvic Girdle,**

##### **2.2. Combined Movements of the Pelvis and Thigh and Muscular Actions**

##### **2.3. Strength of the Hip Joint Muscles,**

##### **2.4. Conditioning of the Hip Joint Muscles,**

##### **2.5. Injury Potential of the Pelvic and Hip Complex;**

- 2.6. The Knee Joint - Tibiofemoral Joint, Patellofemoral Joint, Tibiofibular Joint,
- 2.7. Movement Characteristics, Muscular Actions, Combined Movements of the Hip and Knee,
- 2.8. Strength of the Knee Joint Muscles, and Conditioning of the Knee Joint Muscles,
- 2.9. Injury Potential of the Knee Joint

### **UNIT 3**

The Ankle and Foot - Talocrural Joint, Sub talar Joint, Mid tarsal 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 - Hip Joint, Knee Joint, Ankle and Foot

### **UNIT 4**

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

### **Suggested Books readings**

1. Joseph Hamill, Kathleen M. Knutzen, Timothy R. Derrick, (2015). Biomechanical Basis of Human Movement (4th edition); Lippincott Williams & Wilkins, Philadelphia, USA

### **Practical – II**

#### **SBI-516(P) (Functional Anatomy)**

1. Muscular actions around shoulder, elbow, wrist and fingers for various sports movements
2. Movements that cause injury to shoulder, elbow, wrist and fingers muscles with respect to sports movement
3. Measuring hip range of motion, knee range of motion, ankle/foot range of motion with respect to different activity.
4. Muscular actions around hip and lower extremity for various sports movements
5. Movements that cause injury to hip and lower extremity muscles with respect to sports movement
6. Calculating foot arch and assessing variety of injury with respect to foot position and loading.
7. Vertebral column – measuring movements and injury related to sports movement
8. Calculating range of motion around hip
9. Trunk muscle identification
10. Actions of Muscles during an movement

## **SBI-513(C) RESEARCH METHODS & APPLIED STATISTICS**

### **Learning Objectives:**

1. Introduction to scientific method; introduce research designs which seek to describe variables, establish relationships between variables and/or differences between groups.
2. To study about the various types of research.
3. Evidence-based practice.
4. Ethical principles of human research
5. To study about the literature search and presentation.
6. To study about the preparation of research proposal and dissertation.
7. Academic writing and publishing
8. Gain an understanding and appreciation of statistical theory and its application on sportsbiomechanics
9. Gain knowledge of various methods of analyzing and interpreting data relevant to sport biomechanics, and how to use commonly used methods of analyzing data
10. Gain knowledge on the appropriate interpretation of data collected in sport biomechanics
11. Gain critical thinking on the use of the appropriate statistical method to be incorporated in an experimental investigation in sport biomechanics

### **Learning Outcomes:**

1. Write a research grant proposal
2. Develop a study design (including literature review / analysis / ethics)
3. Understand study conduct
4. Apply study analysis
5. Understand bias and confounding
6. Understand the theories of statistical inferences and apply the appropriate statistical techniques in different settings to solve research problems
7. Use a statistical package such as SPSS to implement these statistical methods
8. Interpret the statistical output produced by SPSS in implementing these statistical methods
9. Write a report using APA format on the statistical analysis
10. To understand and describe fundamental concepts of storing and processing data in computer systems
11. To solve typical data processing problems in science using modern programming environments



## **UNIT I**

### **Introduction**

- 1.1. Nature and Characteristics of Research Process; Scientific & Unscientific methods
- 1.2. Types of Research: Basic & Applied, Quantitative & Qualitative Research
- 1.3. Nature and Type of Data
- 1.4. Measures of Central Tendency & Measures of Dispersion
- 1.5. Concept of Standard Error of Estimates
- 1.6. Graphical Representation of Data
- 1.7. Ethical Issues in Research

## **UNIT II**

- 2.1. Identifying the Research Problem
- 2.2. Meaning and Formulation of Research Hypothesis
- 2.3. Delimitations and Limitations, Needs of Significance of the Study.
- 2.4. Need, Purpose, Kinds and Steps of Literature Review
- 2.5. Methods of Data Collection- Participants, Variables & Instruments Selection
- 2.6. Research Design

## **UNIT III**

### **Statistical Analysis**

- 3.1. Parametric & Non-Parametric Test
- 3.2. Normal Distribution: Properties of Normal Curve, Skewness & Kurtosis
- 3.3. Level of Significance, Type I & Type II errors, one tailed & two tailed hypothesis and Tests.
- 3.4. Procedure of Testing of Hypothesis; Region of Acceptance & Rejection; Null & Alternative Hypotheses
- 3.5. Correlation; Partial & Multiple Correlation Chi-Square Test
- 3.6. Developing norms in the form of grading, Percentile Scale, T-Scale, Scales based on difficulty ratings
- 3.7. Student t-distribution, ANOVA & Post-hoc Tests – LSD & Scheffe test
- 3.8. Data Analysis in Qualitative Research

## **UNIT IV**

### **Writing a Proposal and Thesis**

- 4.1. Thesis and Dissertation Format
- 4.2. Writing of abstract and Research Proposal
- 4.3. Presentation of Research Report
- 4.4. Plagiarism: Copyright violations, Tools to identify Plagiarism
- 4.5. Constitution of Institutional Review Board

## REFERENCES

- Best W. John, Research in Education (Prentice Hall of India Private Limited, New Delhi, 1981).
- Bose N.M., Research Methodology (Sher Niwas Publication, Jaipur, India, 2005).
- Malesh L.M., Methodology of Research in Physical Education & Sports, (Metropolitan, New Delhi, 1994).
- Gay R.L., Airasian Peter, Educational Research, (Merill, Prentice Hall, 1996).
- Thomas R. Jerry, Nelson. Taek, Research Method in Physical Activity (Human Kinetics, 2001).
- Clark H. David, Clarke Harrison H, Research Process in Physical Education Recreation and Health (Prentice Hall Inc. Englewood Cliffs, New Jersey, 1970).
- Fern F. Adward, Advanced focus group research, (Saye Publication, New Delhi, 2001).
- Silverman David, Doing qualitative research, (Saye Publication, New Delhi, 2000).
- Verma, J.P. and Ghufan, M. (2012). Statistics for Psychology: A comprehensive Text. Tata McGraw Hill Education, New Delhi.
- Verma, J.P. (2011). Statistical Methods for Sports and Physical Education. Tata McGraw Hill Education, New Delhi.
- Verma J.P. (2013). Data Analysis in Management with SPSS Software Springer.
- Arun Arthur & Arwn. N. Elaine, "Statistics for Psychology", Prentice Hall, Upper Saddle river INC, 1999.
- Write E. Susan, "Social Science Statistics", Allyn and Bacon INC.

## Practical - III

### Research Methodology and Applied Statistics, SBI-517(P)

1. To prepare the class intervals & write the frequencies by using the tally counts.
2. Computation of Correlation matrix.
3. Calculation of partial correlation.
4. Calculation of multiple correlations.
5. Calculation of t- ratio for related and unrelated groups.
6. Calculation of Z- ratio for testing the hypothesis.
7. Preparing the Percentile Scale.
8. Calculation of Chi-Square.
9. Calculation of the One Way ANOVA with equal & unequal sample sizes

## GENERIC ELECTIVE

### SBI-514 (E) CARE OF ATHLETIC INJURY AND REHABILITATION

#### Learning Outcome:

- Understand the various athletic Injuries and their Rehabilitation
- Able to apply the knowledge of therapeutic Modalities in various injuries
- Gain the Knowledge of Sports Massage and Other Common Injuries

#### Unit-I

##### 1. Introduction

- 1.1. Definition and Concept of Rehabilitation
1. 2. Cateogries of Athletic Injuries : Traumatic , Overuse
1. 3. Stage of Healing, Sign of Inflammation
1. 4. Introduction to athletic rehabilitation,
1. 5. Role of Therapeutic Exercise in rehabilitationof musculo-skeltal athletic injuries

#### Unit-II

##### 2. Therapeutic Modalities

- 2.1. Introduction, Therapeutic effects and uses , Contradiction of following therapeutic modalities
- 2.2. Cryotherapy (Ice Therapy), Short Wave diathermy, Ultra sound Therapy, Contrast bath, Transcutaneous Nerve Stimulation , LASER Therapy

#### Unit-III

##### 3. Sports Massage

- 3.1. Role of Massage in the treatment and rehabilitation of Sports Injuries
- 3.2. Massage and sports performance, pre competition and post competition phase
- 3.3. Psychological Aspect of Sports Massage
- 3.4. Massage and Prevention of Sports Injuries

#### Unit-IV

##### 4. Sports Medicine Problems

- 4.1. Role of Nutrition in Sports
- 4.2. Advantage of Exercise before, during and after Pregnancy
- 4.3. Low Back Pain, Common cause, Stretching and Strengthening exercises for low backpain
- 4.4. Concept of overuse injuries, General approach for treatment of Shin Splint, Tennis Elbow

## **References**

- Roy, Steven and Irvin, Richard (1983) Sports Medicine Prevention, Evaluation , Management and Rehabilitation Prentice Hall, Inc Eaglewood Cliffs , New Jersey
- Zachazewski, J.E. et.al (1996) Athletic Injuries and Rehabilitation W.B Saunders Company, Philadelphia
- Freddie, H.F and David A.S (2001) Sports Injuries Mechanism, Prevention and Treatment. Lippincott Williams and Wilkins, London

## SBI-514 (E) Sports Training

### Learning Outcome

- Understanding of Load and its various components
- Able to plan various program to develop motor abilities
- Application of Planning and Periodization for the performance enhancement.

#### **UNIT –I**

##### **1. Introduction**

1.1. Meaning and Definition of Sports training, Coaching, conditioning

1.2. Aim and Task of Sports Training

1.3. Principles of Sports Training

#### **UNIT-II**

##### **2. Training Load**

2.1.1. Definition of Training Load

2.1.2. Types of training Load

2.1.3. Factors of Training Load

2.1.4. Phase and Means of Recovery

##### **2.2. Over Load:**

2.2.1. Meaning of Over Load

2.2.2. Cause of Symptoms of Overload

2.2.3. Tackling of Overload

#### **UNIT-III**

##### **3. General Motor Abilities**

##### **3.1. Strength**

3.1.1. Concept and Types of Strength

3.1.2. Methods of Strength Training

##### **3.2. Endurance**

3.2.1. Concept and Types of Endurance

3.2.2. Methods of Endurance Training

##### **3.3. Speed**

3.3.1. Concept and Types of Speed

3.3.2. Methods of Speed Training

##### **3.4. Flexibility**

3.4.1. Concept and Types of Flexibility

3.4.2. Methods of Flexibility

#### **UNIT-IV**

##### **4. Technical and Tactical Training**

4.1.1. Concept of Technical and Tactical Training

4.1.2. Method of Technical and Tactical Training

## **4.2. Planning**

### **4.2.1. Principle of Planning**

### **4.2.2. Types of Training Plan**

## **4.3. Periodization**

### **4.3.1. Meaning of Periodization**

### **4.3.2. Aim and Contents of Periods**

### **4.3.3. Types of Periodization**

## **References:**

- Dick W. Frank , Sports Training Principles, 4<sup>th</sup> Ed (London :A & c Black Ltd.) 2002
- Eane D Principles of Sports Training (Berlin: Sports Veulag), 1982
- Matveyev, L.P Fundamentals of Sports Training (Moscow: Progress Publishers), 1977
- Singh, Hardayal , Science of Sports Training (New Delhi: DVS Publications), 1991
- Tudor , Bompa Periodization for Sports Human Kinetics , 2005 IInd Edition
- Uppal, A.k Principles of Sports Training (Delhi : Friends Publication 2001)

## SEMESTER II

### SBI-521(C) Fundamental of Movement Analysis

#### Learning Outcome:

- Understand the Fundamental of Measurement system in reference to movement
- Able to apply the knowledge of Movement Analysis
- Gain the Knowledge and application of Photography in Sports.

#### UNIT-I

##### 1. Introduction to Movement Analysis

- 1.1. Components of Movement Analysis
- 1.2. Concept of Mechanical Analysis
- 1.3. Features of Movement analysis
- 1.4. Fundamental of Film Analysis
- 1.5. Limitation of Movement Analysis

#### UNIT-II

##### 2. General Properties of Measurement System

- 2.1. Structure of a measurement System
- 2.2. Analog to Digital Conversion of Signals
- 2.3. Requirement of Locomotion Measurement System
- 2.4. Absolute Spatial Reference System

#### UNIT-III

##### 3. Measurement of Locomotion Kinematics

- 3.1. Exoskeletal Systems
- 3.2. Stereometric Methods
- 3.3. Stereophotographic Methods
- 3.4. Stereometric Methods
- 3.5. Source of Error in Kinematics Measurement
- 3.6. Filtering and Numerical Differentiation of Kinematic Data

#### UNIT-IV

##### 4. Fundamentals of Photography

- 4.1. Basic Structure of Camera and Its Types
- 4.2. Components / Features of Camera
- 4.3. Field Setting During data collection
- 4.4. Photographic Error

#### References

- Robertson, D. Gordon E. et. Al. **Research Methods in Biomechanics.** (Champaign etc :Human kinetics publishers, 2004)

- Kreighbaum, Ellen and Barthels. **Biomechanics – A qualitative Approach for studying Human movement.** Third edition (New York : MC millan publishing company, 1990)
- Bunn, John W. **Scientific Principles of Coaching,** Second Edition. (Englewood cliffs, New Jersey : Prentice Hall, Inc. 1972)
- Scott, M.G. (2005) *Analysis of Human Motion,* New York.



## **SBI-522(C) INSTRUMENT FOR RECORDING AND ANALYSING SPORTS MOVEMENTS**

### **Learning Objectives:**

- 1.To study about cinematography and video analysis of two and three dimension
- 2.To study about the force platform and application of force measurement in sports biomechanics
- 3.To study about EMG in detail
- 4.To study about other techniques for the analysis of sports movements

### **Learning Outcomes:**

- 1.Confidence to handle state of art measurement devices for biomechanical testing
- 2.To plan, prepare, measure and analyse biomechanical experiments
- 3.To apply theoretical understanding and practical knowledge to specialized case studies
- 4.To evaluate state of the art biomechanical diagnostics in competitive sports as well as in recreation, rehabilitation and health scenarios
- 5.To create reasoned diagnostics / experimental studies for competitive sports and sports products

### **UNIT 1**

- 1.1 Cinematography and video analysis
- 1.2. Uses of cine and video analysis in sports biomechanics
- 1.3. Levels of biomechanical analysis of sports movements
- 1.4. Recording the movement, Cine or Video
- 1.5. Recording the image—Cameras and Lenses
- 1.6. Displaying the image—Cine projectors and Video players, obtaining body coordinates,
- 1.7. Two-dimensional or three-dimensional analysis,
- 1.8. Problems and sources of error in motion recording

### **UNIT 2**

- 2.1. Experimental procedures - Two-dimensional recording procedures
- 2.2. Three-dimensional recording procedures
- 2.3. Data processing, Data smoothing, filtering and differentiation
- 2.4. Body segment inertia parameters, Segment orientations, Data errors

### **UNIT 3**

- 3.1. Force platforms and external force measurement –
- 3.2. Introduction and equipment considerations
- 3.3. General equipment considerations
- 3.4. The detector-transducer
- 3.5. Signal conditioning and recording
- 3.6. Operational characteristics of a force platform system Experimental procedure

### 3.7. Calibration

### 3.8. Data processing, examples of the use of force measurement in sports biomechanics

## UNIT 4

### 4.1. Electromography - Introduction

### 4.2. Experimental considerations,

### 4.3. Recording the myoelectric (EMG) signal EMG electrodes, Cables, EMG amplifiers, Recorders,

### 4.4. Experimental procedures,

### 4.5. Data processing, temporal processing and amplitude analysis (time domain analysis), Frequencydomain analysis

### 4.6. EMG and muscle tension, Isometric contractions, Non-isometric contractions

### 4.7. Analysis of sports movements - Single-plate photography, Automatic tracking opto-electronic systems, Electro goniometry, Accelerometry, Pressure measurement

## Suggested readings

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. Knudson, Duane V. Fundamentals of biomechanics, Springer, 2007

## Practical

1. 2D and 3D camera
2. Sensors
3. EMG
4. Force Plate
5. Dynamometer

## **SBI-523 (C) KINANTHROPOMETRY**

### **Learning Objectives:**

1. To provide the knowledge of various methods of measuring body composition in humans.
2. To study about the bone length and width with respect to sports performance

### **Learning Outcomes:**

1. Demonstrate greater practical skills in a range of anthropometric measurements of stature, skeletal breadths, girths and skinfolds
2. Record, analyse and evaluate anthropometric measurements
3. Safely and effectively use instrumentation and equipment to assess and record human anthropometry, physique and somatotype

### **UNIT 1**

1.1. Anthropometry – definition- history- need, scope and importance

1.2. Preliminary considerations- subject- data collection- anthropometry equipment – anthropometry profile

1.3. Human body composition- densitometry; under water weighing- dual energy x ray absorptiometry- skin fold method- bioelectrical impedance anthropometric model- adipose tissue –muscle – bone

### **UNIT 2**

2.1. Anthropometric land marks definitions- vertex-supra sternale-epigastrale-thelion-acromiale- radiale-stiliondactylion- iliocristale-iliospinale-trochanterion- tibial mediale and laterale

2.2. Heath carter somatotype method anthropometric

2.3. Photoscopic somatotype methods- definition- endomorphy- mesomorphy- ectomorphy

2.4. Anthropometric landmarks- reference land marks- marked land marks- basic measurements

### **UNIT 3**

3.1. Skinfold measurement

3.2. Locations of skinfold sites- cheek-chin-pectoral-axilla- abdomen iliac crest supraspinale- subscapular-triceps-biceps-patella-mid thighproximal calf-medial calf- waist hip ratio

3.3. Body mass index

3.4. Fat free index

### **UNIT 4**

4.1. Anthropometric measurement

4.2. Length and breadth measurement

4.3. Technique and procedures- Length, Breadth and Girth

4.4. Heath carter somatotyping testing and classification procedure

4.5. Report generation technique

## **PRACTICAL**

1. Height, weight, body composition etc.
2. Somatotype
3. Skinfold measurements
4. Lengths and breadths of the bone
5. Girths of the muscles

### **Discipline Specific Elective SBI-524 (E) METHODS IN NEUROMECHANICS**

#### **Learning Objectives:**

1. To study about electrical stimulation (muscular and neural stimulation)
2. To study about mechanical properties of the musculoskeletal system, muscle stiffness, spinal reflexes, cortical reflexes, motor learning, kinematic and kinetic analysis
3. To study about neural control of muscle force during fatigue
4. To study about biomechanical movement synergies

#### **Learning Outcomes:**

1. To understand theories of motor control and neuromechanics, principles of motor learning and their practical implications, and how these relate to both the neuromuscular physiology and biomechanics,
2. To understand advanced methods of biomechanical testing and to evaluate related up-to-date research outcomes,
3. To read scientific publications in English and prove the understanding in presentations and discussions,
4. To explain and apply the principles of biomechanics, motor control and neuromechanics,
5. To apply the obtained knowledge to creatively solve problems relating to sport, exercise, human movement and rehabilitation,
6. To debate theories and techniques used in the fields of biomechanics, human movement and neuromechanical control.

## **UNIT 1**

**1.1. Biomechanics as an Interdisciplinary, Introduction, Measurement, Description, Analysis, and Assessment,**

**1.2. Biomechanics and its Relationship with Physiology and Anatomy;**

**1.3. Signal Processing – Introduction, Auto- and Cross-Correlation Analyses, Frequency**

**1.4. Analysis, Ensemble Averaging of Repetitive Waveforms**

## **UNIT 2**

**2.1. Kinematics and Kinematic Conventions**

**2.2. Direct Measurement Techniques and Imaging Measurement Techniques**

**2.3. Processing of Raw, Kinematic Data, Calculation of other Kinematic Variables, Problems Based on Kinematic Data**

**2.4. Anthropometry, Scope of Anthropometry in Movement Biomechanics Kinetics, Forces and Moments of Force**

## **UNIT 3**

**3.1. Mechanical Work, Energy, and Power,**

**3.2. Calculation of Internal and External Work, Power Balances at Joints and Within Segments, Problems Based on Kinetic and Kinematic Data;**

**3.3. Three-Dimensional Kinematics and Kinetics,**

**3.4. Synthesis of Human Movement**

## **UNIT 4**

**4.1. Muscle Mechanics – Introduction,**

**4.2. Force-Length Characteristics of Muscles,**

**4.3. Force-Velocity Characteristics,**

**4.4. Muscle Modeling; Kinesiological**

**4.5. Electromyography – Introduction,**

**4.6. Electrophysiology of Muscle Contraction,**

**4.7. Recording of the Electromyogram and Processing of the Electromyogram,**

**4.8. Relationship between Electromyogram and Biomechanical Variables,**

**4.9. Biomechanical Movement Synergies**

## SBI-524(E) BIOMECHANICS OF SPORTS INJURIES

### **Learning Objectives:**

- Understand the injury to that occurs on bone, cartilage, muscle and ligament to movements.
- Understand how specific sports surfaces behave
- Understand the influence that sports surfaces have on injury
- Understand the influence of footwear on injury in sport and exercise, with particular reference to impact absorption and rearfoot control appreciate the injury moderating role of other protective equipment for sport and exercise
- Understand the effects of technique on the occurrence of musculoskeletal injury in a variety of sports and exercises.

### **Learning Outcomes:**

Knowledge to overcome different types of injury on various structures due to sports equipment and technique on injury.

### **Unit 1**

Causes of injury and the properties of materials - Causes of injury, Biological and other materials, Response of a material to load, Stress and strain, Elastic modulus and related properties, Plasticity and strain energy, Toughness and crack prevention, Hardness, Creep, Fatigue failure, Non-homogeneity, anisotropy and viscoelasticity, Stress concentration, Bone, Structure and composition

### **Unit 2**

Bone: loading and biomechanical properties, Cartilage, Structure and composition, Biomechanical properties, Muscle properties and behaviour, Muscle elasticity and contractility, Maximum force and muscle activation, Mechanical stiffness, The stretch-shortening cycle, Ligament and tendon properties, Factors affecting properties of biological tissue, Immobilisation and disuse, Age and sex, Exercise and training, Warm-up

### **Unit 3**

The effects of sports equipment and technique on injury: Sports surfaces – Introduction, Characteristics of sports surfaces, Specific sports surfaces, Biomechanical assessment of surfaces, Injury aspects of sports surfaces.

### **Unit 4**

Footwear: biomechanics and injury aspects – Introduction, Biomechanical requirements of a running shoe, The structure of a running shoe, Footwear and injury, Impact and the running shoe, Running shoes and rear foot control

### **Unit 5**

Other sports and exercise equipment and injury – The head and neck, The upper extremity, The lower extremity, Alpine skiing: release bindings. Musculoskeletal injury—technique aspects, Introduction, The head and trunk, The upper extremity, The lower extremity.

**Suggested readings:**

1. Bartlett, Roger. (1999). Sports biomechanics: Preventing injury and improving performance, Routledge Publications

**Practical:**

- RICE therapy
- First aid to open wound injuries

**This course is offered for the students from other division in Department of Sports Sciences and from other Department in University (Generic Elective)**

**SBI-525(E) PHYSICS IN SPORTS**

**Learning Objectives**

1. Understand the physics behind popular sports
2. Use physical principles to solve problems relating to the physics of sports
3. Use sport as a means of enhancing science classes

**Learning Outcomes**

1. Learn how speed and acceleration relate to sprinting
2. Understand how Newton's laws of motion determine the path of a football
3. Applying the principles of rotational motion to gymnastics, figure skating and diving
4. Learn what the optimum launch angle are for long jump and other sports projectiles
5. Apply basic aerodynamic principles to the javelin, ski jumping and swimming
6. Estimate the effect of wind speed, altitude, temperature, and equipment on various sports.

**Unit 1** Speed, acceleration and Usain Bolt - Speed, average and instantaneous speed, velocity, difference between speed and velocity, acceleration., Usain bolt, Speed of animals, light, sound and long distance

**Unit 2** Newton's laws of motion – application in football and other games, estimate the flight path of a football, the concept of momentum and basketball bounce, impulse and momentum, conservation of momentum.

**Unit 3** Pirouettes and rotational motion – angular speed, velocity, and acceleration, understanding rotational motion in discus, centripetal force and gymnastics, moment of inertia and angular momentum in gymnastics, conservation of angular momentum.

**Unit 4** Projectiles in sports: projecting for vertical distance – understanding projections for vertical distance, projecting for horizontal distance - understanding projections for horizontal distance, projecting for accuracy - understanding projection for accuracy and speed. Aerodynamic in sports - drag force, lift force, magnus effect, understanding aerodynamic lift force and the magnus effect in sports

### **Suggested readings**

Ellen Kreighbaum and Katharine M. Barthels. (1985). Biomechanics: A Qualitative Approach for Studying Human Movement (Second Edition), Macmillan Publishing Company, New York, USA

#### **SBI-526 (P) Practical**

1. Different types of camera, features of cameras, position of camera (height, tripod, light, frame per second, shutter speed, pixel, resolution etc.
2. Stick figure

#### **SBI-527 (P) Practical**

1. 2D and 3D camera
2. Sensors
3. EMG
4. Force Plate
5. Dynamometer

#### **SBI-528 (P) Practical**

1. Height, weight, body composition etc.
2. Somato type
3. Skinfold measurements
4. Lengths and breadths of the bone
5. Girths of the muscles



**SEMESTER III**  
**Dynamics of Gait: SBI-531 (C)**

**Learning Objectives:**

- To provide the knowledge of mechanical concepts as applied to human movement.
- To study about gait analysis of dynamic movements
- To study the three-dimensional motion analysis of human movement
- To study about clinical gait analysis

**Learning Outcomes:**

1. Demonstrate an objective and scientific approach to the study of human motion
2. Critically analyse human movement to be able to identify normal normal and pathological gait function and the parameters integral to successful movement execution
3. Identify and explain biomechanical factors during human motion that interact and contribute to mechanism of sporting injury
4. Describe how the biomechanical properties of tissue adapt to loading
5. Explain and apply the principles of kinetic and kinematic data collection and analysis of various biomechanical methods and equipment
6. Critically analyse biomechanical data on a movement task and author a research report that provides the appropriate recommendations aimed at improving performance, reducing the likelihood of injury and/or enhancing rehabilitation

**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

**UNIT-II**

Pathological and other abnormal gaits - Specific gait abnormalities, Walking aids Treadmill gait

**UNIT III**

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 IV**

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

**UNIT V**

Applications of gait analysis - Clinical gait assessment, Conditions benefiting from gait assessment Future developments

### **Suggested readings**

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 company.
4. Grisaffi D. Posture and core conditioning Published by David Grisaffi and Personal Fitness Development in the United States of America.
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.

### **Practical**

1. Walking gait
2. Race walking gait
3. Sprinting gait
4. Jogging gait
5. Long distance running gait

## **Performance Analyses in Sports: SBI-532 (C)**

### **Learning Objective:**

- Basic Understanding of Component of Notational Analysis
- Understand the techniques and systems used to observe and analyse the tactical and technical aspects of sporting performance
- Statistically Analyse and describe sporting performance using video analysis

### **UNIT-I**

#### **1. Introduction to Notational Analysis**

**1.1.1 Concept of Notational Analysis**

**1.1.2 Need for Objective Information**

**1.1.3 Anthropometric Component of Notational Analysis**

**1.1.4 Physiological Components of Notational Analysis**

**1.1.5 Psychological Component of Notational Analysis**

### **UNIT-II**

#### **2. Biomechanical Component of Notational Analysis**

**2.1.1. Notational Analysis and Data Collection**

**2.1.2. Knowledge of Performance in Various Sports**

**2.1.3. Notation of Results**

**2.1.4. Notation by Verbal and Visual Mechanism**

**2.1.5. Notational by Video and Audio Mechanism**

## **UNIT-III**

### **3. Notational Analysis methods**

- 3.1.1. Application of Computer in Notational methods
- 3.1.2. Benefits and Limitation of Computer in Notational Analysis
- 3.1.3. Application of Video and Audio Tapes
- 3.1.4. Benefits and Limitation of Audio in Notational Analysis

## **UNIT-IV**

### **4. Application of Notational Analysis**

- 4.1.1. Statistical Analysis of Performance Data
- 4.1.2. Notations in Team Sport
- 4.1.3. Soccer
- 4.1.4. Basketball
- 4.1.5. Volleyball
- 4.1.6. Notations in Individual Sport
- 4.1.7. Tennis
- 4.1.8. Badminton

### **References:**

1. Mike Hughes, Ian M. Franks (2004) "Notational Analysis of Sport: Systems for Better Coaching and Performance in Sport., editors. ISBN: 0415290058, Routledge Publishing (an imprint of Taylor & Francis Books Lt)
2. Mike Hughes, Ian M. Franks (2015) Essential of Performance Analysis in sport Routledge Publishing (an imprint of Taylor & Francis Books Lt)
3. Gil Fried, Ceyda Mumcu , (2017) Sports Analytics A data-driven approach to sport business and management, 1st Edition

## Biomechanical Analysis of Human Movement: SBI-533 (C)

Learning Outcome:

- Develop an Understanding of Various types 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 movements in relation with mechanics and justify the efficiency of it.

### UNIT-I

#### 1. Methods of Analysis of Human Movements

- 1.1.1. Qualitative Analysis
- 1.1.2. Pre-Requisite Information
- 1.1.3. Basic Step of Observation Method
- 1.1.4. Identification of Faults
- 1.1.5. Instructions
- 1.1.6. Quantitative Analysis
- 1.1.7. Creation of Model
- 1.1.8. Video Recording with accuracy
- 1.1.9. Vertex Digitization
- 1.1.10. Draw Trajectory of Vertex
- 1.1.11. Stick Figure
- 1.1.12. Predictive Analysis

### UNIT-II

#### 2. Mechanical Analysis of Locomotion.

- 2.1.1. Walking
- 2.1.2. Running
- 2.1.3. Jumping
- 2.1.4. Hopping or Leaping

### UNIT-III

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

- 3.1.1. Pulling
- 3.1.2. Throwing
- 3.1.3. Hitting
- 3.1.4. Kicking
- 3.1.5. Stroking

### UNIT-IV

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

- 4.1.1. Temporal Phase, Joint Motion

4.1.2. Identification of Predominant active muscle (Each Joint)

4.1.3. Identifications of Angular Kinematics and Impacts

4.1.4. Biomechanical Analysis to Understand Injury Development Wolffs Law

#### References:

- Efficiency of Human Movement by marrion Broer, W. B. saundens company
- Analysis of Human motion textbook in kinesiology. M. Gladys Scott. Appleton-century-crofts Inc., N.York.
- Sports Biomechanics, reducing injury and Improving performance, roger Battlett, Taylor and Francis, London and M.York.
- Kinesiology Scientific Basis of Human Motion K. Luttgens and K.F.Wells., Saundens college publishing, N.York.

### **Strength and Conditioning and application of biomechanics: SBI-534 (E)**

#### Learning Objectives

1. Main tests and analysis for the determination of an athlete's physical performance, mainly in the field of strength diagnostics.
2. Evaluation of the specific physiological needs of different types of sports.
3. Planning and performing of specifically adopted tests.
4. Presentation of results and how to communicate scientifically high-end methods to athletes or coaches.
5. Specific sports scenarios and athletes needs to enhance performance.

#### Learning Outcomes

1. Understand the principals of analysis of physical performance in competitive sports
2. Apply practical tests for strength and conditioning and evaluate outcomes for specific sports.
3. Understand, present and discuss scientific articles on recent developments in performance analysis, strength and conditioning.
4. Discuss the need of scientific support and development for competitive/elite sports.
5. Evaluate applications of appropriate methods for kids, elderly, and health and rehabilitation scenarios.
6. Design and conduct a research project for strength and conditioning assessments in competitive/elite sports.
7. Communicate/present scientifically high end methods and results to athletes or coaches

#### **UNIT-I**

The Principles of Training, Progression, Specificity, Overload, Reversibility, Physiological Adaptations to Anaerobic Training, Muscular-Hypertrophy and Force Production, Energy

## Production Capacity of the Muscle, Specific Fiber Type Adaptations

### **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

### **UNIT-III**

Biomechanical assessment of Resistance exercise and 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.

### **UNIT-IV:**

Biomechanical assessment of Power, Speed, and Agility–Plyometric Training, Speed Training, Agility Training. Structure and Function of Body Systems 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.

## Practical

1. Biomechanical measurements of resistance training
2. Biomechanical assessment of plyometric, speed, agility exercise, etc.
3. Biomechanical assessment of static and dynamic exercises.

## Motor Control in Sports: SBI-534 (E)

### Learning Outcome:

- Able to differentiate various Motor Learning Process
- Able to describe the Mechanism responsible for the movement
- Develop an Understanding of how the body controls posture and the Factors of Inefficiency

### UNIT-I:

#### 1. Basics of Motor Control

1.1.1. Concept of motor control

1.1.2. Theories of Motor Control

1.1.3. Concept of Motor Learning

1.1.4. Forms of Learning

1.1.5. Non-Associative Learning

1.1.6. Associative Learning-

Classical Conditioning, Operant Conditioning, Procedural and Declarative Learning

### UNIT-II:

#### 2. Physiology of Motor Control

2.1.1. Proprioception and Motor Control-

Muscle Spindle, Stretch Reflex Loop, Golgi tendon organ, Joint Receptors

2.1.2. Vision and Motor Control

2.1.3. Action System-Motor Cortex and its functions

2.1.4. Role of The Cerebellum and Basal Ganglia

### UNIT-III:

#### 3. Posture and Balance Control

3.1.1. Defining the task and System of Postural Control

3.1.2. Motor Mechanism for Postural Control

3.1.3. Senses Contribution for postural Control

3.1.4. Adaption of Senses for Postural Control

### UNIT-IV:

#### 4. Motor control and performance

4.1.1. Classification of Motor Skill

4.1.2. Performance Characteristics of Complex Skills

4.1.3. Causes of Inefficient Movement

#### 4.1.4. Efficiency of Muscle

#### References:

- Winter A. David 1979: Biomechanics of Human Movement John Wiley and Sons, Inc USA
- Cook A. Shumway, Woollacott Marjorie; Motor Control Theory and Practical Application Lippincott Williams & Wilkins, Baltimore USA
- Schmidt RA, Motor Control and Learning 2<sup>nd</sup> Ed Champaign, I L: Human Kinetics, 1988 Perry J. Gait Analysis: Normal and Pathological Function. Thorofare, NJ: Slack Inc., 1992

### Generic Elective Exercise Physiology: SBI-535 (E)

#### Learning Outcome:

- Able to describe the basic physiology of the body
- Gain the physiological knowledge of muscle and energy systems used in varied sports
- Able to apply the knowledge of supplements for the enhancement of performance

#### UNIT-I:

##### 1. Introduction of Exercise Physiology

1.1.1. Meaning and definition of Exercise and Exercise Physiology

1.1.2. Role and Importance of Exercise Physiology in the Field of Physical Education and sports

1.1.3. Impact of Exercise on work at Cellular Level

1.1.4. Sliding Filament Theory

1.1.5. Various changes during Muscular Contraction

#### UNIT-II:

##### 2. Energy System and Metabolism

2.1.1. ATP-PC System

2.1.2. Glycolytic System

2.1.3. Oxidative System

2.1.4. Metabolism of Fat, Protein and Carbohydrate

2.1.5. Electrolyte balance and water Balance

#### UNIT-III:

##### 3. Physiological Development of Motor abilities and Pulmonary Ventilation

3.1.1. Physiological Aspect of Development of Strength, Endurance, Speed, Agility and Coordination

3.1.2. Ventilation During Exercise and Rest



3.1.3. Alveolar Ventilation and Second Wind

3.1.4. Respirator response to high altitude

3.1.5. Cardiovascular response to Exercise

#### **UNIT-IV:**

#### **4. Doping and supplements**

4.1.1. Cardiovascular Enhancer

4.1.2. Blood Doping

4.1.3. Beta Blockers

4.1.4. Effect of Drugs and doping on athletic performance

4.1.5. Diet Supplements and performance

4.1.6. Diet and Fluids

4.1.7. Supplements and Their Effects

4.1.8. Exercise and training in Females

#### **References:**

- Katch  
L. Victor, Katch I. Frank Exercise Physiology, Energy, Nutrition and Human Performance 5<sup>th</sup> Edition Human Kinetics
- Guyton, Arthur C. Text Book of Medical Physiology. (Philadelphia: W. B. Saunders Company, 1976)
- James C. Clough, Fundamental Human Anatomy (Lea & Febiger, Philadelphia, 1971)
- Mathew, D. K. and Fox E. L., Physiological Basis of Physical Education and Athletics (Philadelphia: W. B. Saunders Company, 1976)
- Morehouse, I. E. Miller, A. T. Physiology of Exercise. (St. Louis: The C. V. Mosby Company, 1976) 7<sup>th</sup> Edition.
- Pearsevelyr C. Anatomy and Physiology for Nurses (London: Faber & Faber Ltd. 1926)

#### **Yogic Science: SBI-535 (E)**

#### **Learning Objectives:**

- Understand and how biomechanics can be used in yoga perspective.
- Understand the use of theoretical and practical biomechanical methods that is commonly used with hinyoga

#### **Learning Outcomes:**

- Discover yoga to maintain or improve lifelong health and fitness
- Develop a better understanding of how mechanical principles influence yogic movements with health perspective.
- Analyze the stresses and strains in biological tissues by performing static and dynamic yoga as

ana

#### **UNIT-I:**

Yoga sanas, history and need and importance of asanas and types of asanas-Suryanamskar, Stages of asanas, Chakra, Types of chakras, Benefits of Chakras, Yoga basics, Types of Yoga, Benefits of yoga & asanas, Yoga mudra, Types of Mudras, Benefits of mudras, Eight stages of yoga, Yama, Niyama, Asana, Pranayama, Prathyakara, Dharana, Dyana, Samadhi

#### **UNIT-II:**

Standing and twisting asana are Artha Chandrasana (Half-moon), Bhekasana (Frog), Chakrasana (Wheel), Gomukshana (Cow faced pose), Hanumasana (Monkey pose), Makrasana (Crocodile), Parvottanasana (Intense stretch to side), Salambasarvangasana (Shoulder stand), Simhasana (Lion), Ustrasana (Camel), Virabhadrasana & rkasana (Tree).

#### **UNIT-III:**

Prone and supine asana are Anatasana (Anat's pose), Janusirasasana (Head to Knee Forward Bend), Malasana (Garland), Suptapathchadsasana (Catching the big toe supine pose), Half bow ardhadhaurasana, Jathraparivatasana (Belly twist), Ananda Balasana (Joyful baby), Suptapadangust asana (Supine hand to toe) & Pavanamuktasana (Wind relieving pose).

#### **UNIT-IV:**

Inverted asana is Sarvangasana, Chakrasana, Pinchamyurasana (Feathered peacock pose), Artha Navasana (Half boat pose), Bodhakonnasana (Bound angle), Balasana (Child pose), Bhujangasana (Cobra), Dhanurasana (Bow), Garudasana (Eagle pose), Halasana (Plough), Mayurasana (Peacock), Natarajasana (Dance or Lord), Padmasana (Lotus), Salabasana (Locust), Samasthishi (Equal stand), Savasana (Corpse pose), Tadasana (Mountain pose) & Vajrasana (Thunderbolt).

#### **Suggested Reading:**

Francoise et al. Yoga and Pilates for everyone, Joanna Lawrenz, 2006

#### **Practical:**

Kinematic and kinetic assessment for asanas

**Practical – IX (Dynamics of Gait): SBI-536 (P)**

- a) Walking gait
- b) Race walking gait
- c) Sprinting gait
- d) Jogging gait
- e) Long distance running gait

**Practical – X (Performance Analysis): SBI-537 (P)**

Sports Performance Analysis

**Practical – XI (Biomechanical analysis of human movement): SBI-538 (P)**

- a) Stick diagram (basic techniques; anatomical posture, walking, pushup, situps etc.)
- b) Use of reflective markers, joint points for placing markers.
- c) Field setting during data collection.
- d) Kinesiological analysis of free hand exercises

**Practical – XII (MATLAB): SBI-539 (P)**

<b>Course Code: SBI-539 (P)</b>		<b>Course Title: MATLAB</b>
Max Marks:100	Semester III	Credits:100
	Internal:40	External:60
<b>Learning Objectives</b>	<ol style="list-style-type: none"> <li>1. To familiarize the student in introducing and exploring MATLAB &amp; LAB VIEW softwares</li> <li>2. To enable the student on how to approach for solving sports biomechanics problems using simulation tools</li> <li>3. To provide a foundation in use of this softwares for real time applications</li> <li>4. To study about motion detection, text recognition, finding particles, bouncing ball, ball tracking and micro array analysis</li> </ol>	
<b>Learning Outcomes</b>	<ol style="list-style-type: none"> <li>1. To understand the use of Matlab in order to analyse signals in the investigation of human movement</li> <li>2. Enhance the ability to create a Matlab script that can read the data,</li> </ol>	

	improved at a quality, visualize results and compute relevant signal characteristics of various signals relevant in movement science
<b>Suggested readings</b>	<ol style="list-style-type: none"> <li>1. Krister Ahlersten, An Introduction to Matlab.</li> <li>2. Brian Hahn and Dan Valentine, Essential MATLAB for Engineers and Scientists (Fifth Edition).</li> <li>3. Stormy Ataway, Matlab: A Practical Introduction to Programming and Problem-Solving 3<sup>rd</sup> Edition.</li> </ol>
<b>Unit 1</b>	<p>Quick start</p> <ul style="list-style-type: none"> <li>➤ Desktop basics</li> <li>➤ Matrices and arrays</li> <li>➤ Workspace variables</li> <li>➤ Character strings</li> <li>➤ Calling function</li> <li>➤ Plots and programming scripts</li> </ul>
<b>Unit 2</b>	<p>Language fundamentals</p> <ul style="list-style-type: none"> <li>➤ Matrices and magic squares</li> <li>➤ Expressions</li> <li>➤ Entering commands</li> <li>➤ Indexing</li> <li>➤ Types of arrays</li> </ul>
<b>Unit 3</b>	<p>Mathematics</p> <ul style="list-style-type: none"> <li>➤ Linear algebra</li> <li>➤ Operations on nonlinear functions</li> <li>➤ Multivariate data</li> <li>➤ Data analysis</li> </ul>
<b>Unit 4</b>	<p>Graphics</p> <ul style="list-style-type: none"> <li>➤ Basic plotting function</li> <li>➤ Creating mesh and surface plots</li> <li>➤ Display images</li> <li>➤ Printing graphics</li> <li>➤ Working with graphic objects</li> </ul>

<b>Unit 5</b>	Programming <ul style="list-style-type: none"><li>➤ Control flow</li><li>➤ Scripts and function</li></ul>
<b>Practical</b>	1. Using MATLAB software for analysis of kinematic and kinetic analysis during dynamic movement

**SEMESTER-IV**  
**Biomechanical Analysis of Sports Skill: SBI-541(C)**

Learning Outcome:

- Able to understand the Sports Skill based on Advance mechanics
- Develop the knowledge to describe the sports skill related to mechanics.
- Analyze the skill elaborately to enhance the efficiency as well as performance.

**UNIT-I**

**1. Biomechanical Concepts for Analysis**

- 1.1.1. Concept and Application of Center of Gravity, Method to Locate Center of Gravity(Segmentation Method)
- 1.1.2. Center of Mass and its Application
- 1.1.3. Conservation of Angular Momentum
- 1.1.4. Moment of Inertia and Its Application

**UNIT-II**

**2. Mechanical Analysis of Techniques of Track and Field Events**

Analysis of track event:

2.1.Start:

2.1.1. Standing Start

2.1.2. Crouch Start (Bunch, Medium, Elongated)

2.2. Running:

2.2.1. Hurdling

2.2.2. High Hurdles

Analysis of Techniques of Field Events:

2.3. Jumps:

2.3.1. Long jump

2.3.2. High jump

2.4. Throws:

2.4.1. Shot put

2.4.2. Javelin throw

**UNIT-III:**

**3. Analysis of Sports Skill**

3.1. Gymnastics:

3.1.1. Handstand

3.1.2. Forward roll

3.1.3. Cart wheel

3.2. Swimming:

3.2.1. Starting

3.2.2. The turn

### 3.2.3. Front crawl

### 3.2.4. Back Crawl

## UNIT-IV:

### 4. Mechanical Analysis of Selected Games & Sports

Basketball	■	Set shot, Lay-up shot and Pass
Cricket	■	Forward drive & Bowling
Football	■	Kicking, Heading & Throwing
Hockey	■	Hitting, Stopping & Dribbling
Volleyball	■	Serving, Passing & Spiking

## PRACTICALS

1. Use of software's (kinovea, dartfish and maxtraq)
2. Comparative biomechanical analysis of a given technique. (Qualitative and quantitative; using software)

## REFERENCES

- Bunn, John W. **Scientific Principles of Coaching**, Second Edition. (Englewood cliffs, New Jersey: PrenticeHall, Inc. 1972)
- Hall, Susan J. **Basic Biomechanics**, Fourth Edition (Boston etc.: WCB/McGraw-Hill Companies, 2004)
- Hay, James G. **The Biomechanics of Sports Techniques**, Fourth Edition (Englewood cliffs, New Jersey; PrenticeHall, 1993)
- Hay, James G. and Reid J. Gavin, **Anatomy, Mechanics and Human motion**, Second Edition (Englewood cliffs, New Jersey: PrenticeHall, 1988).
- Kreighbaum, Ellen and Barthels. **Biomechanics – A qualitative Approach for studying Human movement**. Third edition (New York: Mcmillan publishing company, 1990)
- Mc.Ginnis, Peter M. **Biomechanics of Sport and Exercise**, Second Edition (Champaign: Human kinetics publishers, 2005)
- Rai Ramesh, **Biomechanics – Mechanical Aspects of human motion** (Mohali Punjab : Agrim Publication, 2003)
- Robertson, D. Gordon E. et. Al. **Research Methods in Biomechanics**. (Champaign etc: Human kinetics publishers, 2004)

## Application of Biomechanics to Physiological Systems: SBI-542(C)

### Learning Objectives:

- To provide the knowledge of mechanical concepts as applied to human physiological systems.
- To study about the heart, lung, and hypothalamus
- To study the biomechanical application on systems that is taxed during exercise.

### Learning Outcomes:

- Develop a better understanding of how mechanical principles influence physiological systems during everyday life.
- Analyze the forces of various biological systems during static and dynamic human activities; analyze the stresses and strains in biological tissues.
- Understand the principles of mechanics that is used to analyze biological systems.

### UNIT-I:

Exercise Limitations, Introduction, Exercise Intensity and Duration, Muscle Metabolism, Muscle Fiber Structure, Muscle Energy Sources, Oxygen Debt, Maximal Oxygen Uptake, Anaerobic Threshold, Oxygen Uptake Kinetics, Bioenergetics Model, Chemical Responses, Training, Cardiovascular Exercise Limitation, Respiratory Limitation, Thermal Limitation, Prolonged Exercise, and Variability of Responses.

### UNIT-II:

Exercise Biomechanics—Introduction, Physics of Movement, Equilibrium and Stability, Muscles and Levers, Energy and Motion, The Energy Cost of Movement, Cost of Transport, Muscular Efficiency, Walking and Running, Basic Analysis, Optimal Control of Walking, Experimental Results, Carrying Loads, Load Position, Lifting and Carrying. Biomechanical Model - Using Carts, Sustained Work, Aging and Training, Gender, Genetics.

### UNIT-III:

Cardiovascular Responses—Introduction, Cardiovascular Mechanics—Blood Characteristics, Vascular Characteristics, Heart Characteristics. Cardiovascular Control, Cardiovascular Mechanical Models, Cardiovascular Control Models, Systemic and Pulmonary Vessels, Model Performance.

### UNIT-IV:

Respiratory Responses—Respiratory Mechanics, Lung Volume and Gas Exchange, Mechanical Properties; Control of respiration – Respiratory Receptors, Respiratory Controller, Effector Organs, Exercise; Respiratory mechanical models, Thermal responses—Thermal Mechanics—Convection, Conduction, Radiation, Evaporation, and Rate of Heat Production; Thermoregulation—Hypothalamus



### **SUGGESTED READINGS:**

1. Arthur T. Johnson. Biomechanics and Exercise Physiology: Quantitative Modelling, CRC press, Taylor & Francis Group, New York, USA, 2008.
2. Duane Knudson, Fundamentals of Biomechanics, Springer publication, 2<sup>nd</sup> Edition, 2007

### **PRACTICAL:**

1. Heart rate, blood pressure
2. Vo<sub>2</sub>max
3. Lung volumes
4. Skin temperature, rectal temperature and oral temperature

### **Clinical Biomechanics: SBI-543(C)**

#### **Learning Outcome:**

- Gain the knowledge of muscle palpation for locating the joint and muscular structure
- Able to differentiate the injuries along with their treatment
- Describe the injury due to the possible mechanical error and also able to recommend the exercise on the basis of mechanics

### **UNIT-I**

#### **1. Introduction of Clinical Biomechanics**

##### **1.1. Concept of Clinical Biomechanics**

##### **1.2. Chiropractic Technique:**

###### **1.2.1. Motion Palpation**

###### **1.2.2. Principles of Palpation Technique**

### **UNIT-II**

#### **2. Foot Mechanics in Locomotion**

##### **2.1. Footwear Influences on walking and Running**

##### **2.2. Plantar Fasciitis, Achilles Tendinopathy**

##### **2.3. Posterior Tibial Tendon Dysfunction**

##### **2.4. Lombard's Paradox**

### **UNIT-III**

#### **3. Knee Clinical Mechanics**

##### **3.1. Knee Patellofemoral Syndrome**

##### **3.2. Knee Iliotibial Band Syndrome**

##### **3.3. Knee Ligaments and Meniscus**

### 3.4. Knee Biomechanical Alteration

## UNIT-IV

### 4. Clinical Mechanics of Hip and Spine

#### 4.1. Hip Joint Dysfunction

#### 4.2. Hip Impingement

#### 4.3. Clinical Biomechanics of Spinal Manipulation

#### 4.4. Biomechanics of Back Pain

## REFERENCES:

- Clinical Biomechanics of the Spine, White and Panjabi 3rd Edition
- Chiropractic Technique, Bergmann, Petter son and Lawrence
- Clinical Biomechanics of Spinal Manipulation, Herzog
- The Biomechanics of Back Pain, Adams, Bogduk, Burton and Nolan
- Spinal Pelvic Stabilization, Hyland
- Motion Palpation and Chiropractic Technique, Faye and Schaffer
- Spinal Adjustive Technique, Esposito and Phillipso

**DISSERTATIONS: SBI-543(C)**

**PROJECT FIELDWORK: SBI-543(P)**