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*)

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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 andexercise 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. SportsBiomechanics.

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 conductedafter 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

M.Sc. Sports Biomechanics: Two-Year (4-Semester) CBCS Programme								
Programme Structure								
Semester – I								
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 *one* 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	-
		Total	**27**	**15**	**-**	**24**	**330**	**420**

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)	Kinanthropomentry	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)	*Generic Elective* 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	-
Total			**27**	**15**	**-**	**24**	**330**	**420**

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 ElectiveAny *one* a. Strength and conditioningand 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
		Total	**26**	**21**	**-**	**16**	**360**	**540**

M.Sc. Sports Biomechanics: Two-Year (4-Semester) CBCS Programme								
Programme Structure								
Semester – IV								
Course Code	**Course Title**	**Course Type**	**Total Credits**	**No. of Credit hours**			**Marks Split**	
				L	**T**	**P**	**Int**	**Ext**
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	-
		Total	**22**	**12**	**-**	**20**	**210**	**240**

M.Sc. Sports Biomechanics

CUMULATIVE CHART

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

Percentage of Theory hours per semester	Percentage of practical hours per semester
39.47%	**60.52%**

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 Raid 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 respectto sports movement
3. Measuring hip range of motion, knee range of motion, ankle/foot range of motion withrespect 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 sportsmovement
6. Calculating foot arch and assessing variety of injury with respect to foot position andloading.
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 incorporatedin 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 statisticaltechniques 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 statisticalmethods
9. Write a report using APA format on the statistical analysis
10. To understand and describe fundamental concepts of storing and processing data incomputer systems
11. To solve typical data processing problems in science using modern programmingenvironments

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

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- 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 is 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 Ghufran,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
- Zachazewkski, 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, 4th 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. Sterephotographic 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. Filed 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 inrecreation, rehabilitation and health scenarios
5.To create reasoned diagnostics / experimental studies for competitive sports and sportsproducts

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 inhumans.
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- densiometry; 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-stliondactylion- 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-tricpeps-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 dateresearch 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 andneuromechanical 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 anddiving
4. Learn what the optimumlaunch angle are for long jump and other sportsprojectiles
5. Apply basic aerodynamic principles to the javelin, ski jumping and swimming
6. Estimate the effect of wind speed, altitude, temperature, and equipment onvarious sports.

Unit 1 Speed, acceleration and Usain Bolt - Speed, average and instantaneous speed, velocity, difference between speed and velocity, acceleration., Usain bolt, Speed of animas, 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 rotator motion in discus, centripetal force and gymnastics, moment of inertia and angular momentum in gymnastics, conservation of angularmomentum.

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

Suggestedreadings

Ellen Kreighbaum and Katharine M. Barthels. (1985). Biomechanics: A QualitativeApproach for Studying Human Movement (Second Edition), Macmillan PublishingCompany, 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. saundersompany.
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 (animprint 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:

- DevelopanUnderstandingofVarioustypesofAnalysisandtheirapplication
- Abletodemonstrateandapplybasicmechanicalandphysicsprinciplestohumanmovements
- Gaintheabilitytodescribethefundamentalmovementsinrelationwithmechanicsandjustifyt heefficiencyofit.

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 Humanmotionatextbookinkinesiology.M.Gladysscott.Appleton-century-croftsInc., 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. Presentationofresultsandhowtocommunicatescientificallyhigh-endmethodstoathletes or coaches.
5. Specific sports scenarios and athletes needs to enhance performance.

Learning Outcomes

1. Understandtheprincipalsofanalysisofphysicalperformanceincompetitivesports
2. Applypracticaltestsforstrengthandconditioningandevaluateoutcomesforspecifics orts.
3. Understand, present and discuss scientific articles on recent developments in performance analysis, strength and conditioning.
4. Discusstheneedofscientificsupportanddevelopmentforcompetitive/elitesports.
5. Evaluate applications of appropriate methods for kids, elderly, and health and rehabilitation scenarios.
6. Designandconductaresearchprojectforstrengthandconditioningassessmentsincompetitive/ 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. AssociativeLearning-
ClassicalConditioning,OperantConditioning,ProceduralandDeclarativeLearning

UNIT-II:

2. Physiology of Motor Control

2.1.1. ProprioceptionandMotorControl-
MuscleSpindle,StretchReflexLoop,Golgitendonorgan,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:

- WinterA.David1979:BiomechanicsofHumanMovementJohnWileyandSons,IncUSA
- CookA.Shumway,WoollacottMarjorie;MotorControlTheoryandPracticalA pplicationLippincottWilliams &Wilkins, Baltimore USA
- Schmidt RA, Motor Control and Learning 2nd Ed Champaign, I L: Human Kinetics,
  1988PerryJ.GaitAnalysis:NormalandPathologicalFunction.Thorofare,NJ:Sl ack 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,KatchI.FrankExercisePhysiology,Energy,NutritionandHumanPerformance5thEditionHumanKinetics
- Guybon,ArthurC.TextBookofMedicalPhysiology.(Philadelphia:W.B.SaunderCompany,1976)
- JamesC.Clouch,FundamentalHumanAnatomy(Lea&Febiger,Philadelphia,1971)
- Mathew,D.K.andFoxE.L.,PhysiologicalBasisofPhysicalEducationandAthletics(Philadelphia:W.B.Saunders Company,1976)
- Morehouse, I.E.Miller, A.T.PhysiologyofExercise.(St. Louis:TheC.V. MosbyCompnay, 1976) 7thEdition.
- Pearsevelyr C. Anatomy and Physiology for Nurses (London: Faber &FaberLtd.1926

Yogic Science: SBI-535 (E)

Learning Objectives:

- Understand and how biomechanics can be used in yoga perspective.
- Understandtheuseoftheoreticalandpracticalbiomechanicalmethodsthatiscommonlyusedwithinyoga

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.
- Analyzethestressesandstrainsinbiologicaltissuesbyperformingstaticanddynamicyogaas

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 Chandrasan (Half-moon), Bhekasan(Frog), Chakrasana (Wheel), Gomukshana (Cow faced pose), Hanumasana (Monkey pose), Makrasana(Crocodile),Parvottanasana(Intensestretchtoside),Salambasarvangasana(Shoul derstand),Simhasana(Lion),Ustrasana (Camel),Virabadrasana & rkasana(Tree).

UNIT-III:
Prone and supine asana are Anatasana(Annat'spose),Janusirasasana(Headto-Knee Forward Bend), Malasana (Garland), Suptapathchadsasana (Catching the bigtoe supine pose), Half bow ardhadhaurasana, Jathraparivatasana (Belly twist), Ananda Balasan (Joyfulbaby), Suptapadangust asana (Supine hand to toe) & Pavanamukthasan(Wind relieving pose).

UNIT-IV:
Inverted asana is Sarvankasan, Cakrasana, Pinchamyurasana (Featheredpeacockpose), ArthaNavasana(Halfboasposter), Boddhakonnasana(Boundangle), Balasana(Childpose), Bhujangasan(Cobra), Dhanurasana(Bow), Garudasana(Eagle pose), Hal asana (Plough), Mayurasana (Peacock), Natarajasana (Dance orLord), Padmasana(Lotus), Salabasana (Locust), Samasthishi (Equalstand), Savasana(Corpsepose), Tadasana(Mountainpose) &Vajrasan(Thunderbolt).

Suggested Reading:
Francoiseetal.Yogaand Pilatesforeveryone,Joannalawrenz,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)

Course Code: SBI-539 (P)		**Course Title:** MATLAB
Max Marks:100	Semester III	Credits:100
	Internal:40	External:60
Learning Objectives	1. To familiarize the student in introducing and exploring MATLAB & LAB VIEW softwares 2. Toenablethestudentonhowtoapproachforsolvingsportsbiomechanicsproblemsusingsimulationtools 3. To provide a foundation in use of this softwares for real time applications 4. Tostudyaboutmotiondetection,textrecognition,findingparticles,bouncingball,ball tracking and micro array analysis	
Learning Outcomes	1. TounderstandtheuseofMatlabinordertoanalysesignalsintheinvestigationofhumanmovement 2. Enhance the ability to create a Matlab script that can read the data,	

	improved ata quality, visualize results and compute relevant signal characteristics of various signals relevant in movement science
Suggested readings	1. Krister Ahlersten,An Introduction to Matlab. 2. Brian Hahnand DanValentine, Essential MATLAB for Engineers and Scientists(Fifth Edition). 3. Stormy At taway, Matlab: A Practical Introduction to Programming and Problem-Solving3rdEdition.
Unit1	Quick start ➢ Desktop basics ➢ Matrices and arrays ➢ Workspace variables ➢ Character strings ➢ Calling function ➢ Plots and programming scripts
Unit 2	Language fundamentals ➢ Matrices and magic squares ➢ Expressions ➢ Entering commands ➢ Indexing ➢ Types of arrays
Unit 3	Mathematics ➢ Linear algebra ➢ Operations on nonlinear functions ➢ Multivariate data ➢ Data analysis
Unit 4	Graphics ➢ Basic plotting function ➢ Creating mesh and surface plots ➢ Display images ➢ Printing graphics ➢ Working with graphic objects

Unit 5	Programming ➢ Control flow ➢ Scripts and function
Practical	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 SportsSkill**

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. Comparativebiomechanicalanalysisofagiventechnique.(Qualitativeandquanti tative;usingsoftware)

REFERENCES

- Bunn, John W. **Scientific Principles of Coaching**, Second Edition.(Englewood cliffs, New Jersey: PrenticeHall,Inc.1972)
- Hall, SusanJ. **Basic Biomechanics**,FourthEdition(Bostonetc.:WCB/MCGraw-HillCompanies,2004)
- Hay, James G.**The Biomechanics of Sports Techniques**, Fourth Edition (Englewood cliffs, NewJersey; PrenticeHall,1993
- Hay, James G. and Raid J. Gavin, **Anatomy, Mechanics and Human motion**, Second Edition (Englewoodcliffs, NewJersey: PrenticeHall,1988).
- Kreighbaum, Ellen and Barthels. **Biomechanics – A qualitative Approach for studying Human movement.** Third edition (New York: MCmillan publishing company,1990)
- Mc.Ginnis, PeterM. **Biomechanics of Sport and Exercise**, Second Edition (Champaign: Human kinetics publishers,2005)
- Rai Ramesh, **Biomechanics – Mechanical Aspects of human motion** (Mohali Punjab :AgrimPublication,2003)
- Robertson, D. GordonE. 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:

- Developabetterunderstandingofhowmechanicalprinciplesinfluencephysiological 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.
- Understandtheprinciplesofmechanicsthatisusedtoanalyzebiologicalsystems.

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–Convention, Conduction, Radiation, Evaporation, and Rate of Heat Production; Thermoregulation–Hypothalamus

SUGGESTED READINGS:

1. ArthurT.Johnson. Biomechanics and Exercise Physiology: Quantitative Modelling, CRC press, Taylor & Francis Group, Newyork, USA, 2008.
2. Duane Knudson, Fundamentals of Biomechanics, Springer publication, 2nd Edition,2007

PRACTICAL:

1. Heartrate,bloodpressure
2. Vo2max
3. Lungvolumes
4. Skintemperature,rectaltemperatureandoraltemperature

Clinical Biomechanics: SBI-543(C)

Learning Outcome:

- GaintheknowledgeofMusclepalpationforlocatingtheJointand MuscularStructure
- AbletodifferentiatetheInjuriesalongwiththeirtreatment
- DescribetheInjurydue tothepossiblemechanicalerrorand alsoabletorecommend theexerciseon thebasis ofmechanics

UNIT-I

1. **IntroductionofClinicalBiomechanics**
   - 1.1. Concept of Clinical Biomechanics
   - 1.2. Chiropractic Technique:
     - 1.2.1. MotionPalpation
     - 1.2.2. PrinciplesofPalpationTechnique

UNIT-II

2. **FootMechanicsinLocomotion**
   - 2.1. FootwearInfluencesonwalkingandRunning
   - 2.2. PlantarFasciitis,AchillesTendinopathy
   - 2.3. PosteriorTibialTendonDysfunction
   - 2.4. Lombard'sParadox

UNIT-III

3. **KneeclinicalMechanics**
   - 3.1. KneePatellofemoralSyndrome
   - 3.2. KneeIliotibialBandSyndrome
   - 3.3. KneeLigamentsandMeniscus

3.4. KneeBiomechanicalAlteration

UNIT-IV

4. ClinicalMechanicsofHip andspine

4.1. HipJointDysfunction
4.2. Hip Impingement
4.3. ClinicalBiomechanicsofSpinalManipulation
4.4. BiomechanicsofBackPain

REFERENCES:

- Clinical Biomechanics of the Spine, Whiteand Panjabi3rdEdition
- Chiropractic Technique, Bergmann, Petter son and Lawrence
- Clinical Biomechanics of Spinal Manipulation, Herzog
- The Biomechanics of BackPain, Adams, Bogduk, Burton and Nolan
- SpinalPelvicStabilization,Hyland
- MotionPalpationandChiropracticTechnique,Faye andSchaffer
- Spinal Adjustive Technique, Esposito and Phillipso

DISSERTATIONS: SBI-543(C)

PROJECTFIELDWORK: SBI-543(P)