

**MASTER OF SCIENCE IN SPORTS BIOMECHANICS FACULTY OF SPORTS SCIENCES
RAJIV GANDHI UNIVERSITY**



SCHEME OF EXAMINATION, STRUCTURE & COURSE CONTENT

FOR THE DEGREE OF

Master of Science (M.Sc.) in Sports Biomechanics
FOUR SEMESTERS (TWO YEARS) REGULAR DEGREE PROGRAMME
2020-2022

SYLLABUS DETAILS

Title of the Course: Master of Science (M.Sc.) in Sports Biomechanics

Duration of the Course: Two Years (Four Semesters)

Course Objective:

One of the fundamental assumptions of the proposed curriculum is based on possibilities of independent thinking, ability to integrate and synthesize from a trans-disciplinary and multicultural perspective, to evolve a knowledge based system for preparing expert in Sport Biomechanics Enthusiast of India who would contribute and participate effectively in the emergent world of Sport, with capacities to remain locally relevant and globally effective.

1. Not only confined to the knowledge base and theoretical foundations of the discipline of Sports Biomechanics. It will also attend to the pedagogical considerations emanating from experiential learning, research-driven problem solving and mentoring athlete.
2. Socially driven projects, field/laboratory training and simulations utilizing state-of-the-art knowledge systems and technological facilities.
3. Curriculum proposes to have a strong interface between regular as well as innovative teaching pedagogies.
4. Empower the students to inculcate specific job oriented skills, as well as building other behavioral skills and competencies to cater to the needs of athletes and coaches.
5. The Course is designed to have fine blend of virtual and actual class rooms for imparting knowledge by video lectures, small group discussions, tutorials, individual presentations and projects.
6. Students will learn about the analysis of movement, skeletal disorders, laboratory techniques, general research methods and other topics important to your understanding of biomechanics and how it relates to other fields

Evaluation and Award of Grades

Weightage of marks: The weightage of marks between continuous Internal Assessment and End Semester Examination shall be 20 and 80 respectively.

Passing Minimum: A student is declared to have passed a given course only when he/she secures a minimum of 50 % marks in the End-Semester Examination and 50 % marks for the internal assessment component.

Eligibility

Bachelor's Degree in Sports Sciences / Physical Education and Sports / Physics/ Physiotherapy / Computer Science / Computer Application /Information Technology / Software Engineering /Statistics / Physics / Applied Sciences / Engineering (Computer Science / E&I / IT)

or equivalent thereto in 10+2+3 or 10+2+4 pattern from a recognized university with a minimum of 55% marks in aggregate with 5% relaxation for (SC/ST). Proficiency in Sports is desirable for the candidates who take up above mentioned courses, but he/ she must be medically fit and free from any deformities.

The minimum number of seats in to start the program shall be ten (10). If the course is discontinued due to this reason, than the fee will be refunded to provisionally selected candidates.

SCHEME OF EXAMINATION

SEMESTER I

Course Code	Course Name	Credit	Teaching Hours	Internal Marks	External Marks	Total Marks
PART- A (THEORY)						
SBI-511 (C)	Introduction to Sports Biomechanics	4	64	20	80	100
SBI-512 (C)	Fundamental of Anatomy and Kinesiology	4	64	20	80	100
SBI-513 (C)	Research Methodology in Sports Sciences	4	64	20	80	100
SBI-514 (C)	Measurement & Evaluation in Sports Science	4	64	20	80	100
TOTAL		16	256	80	320	400
ELECTIVE (Choose any one)						
SBI-515 (E)	Sports Physiology	4	64	20	80	100
SBI-516 (E)	Sports Management	4	64	20	80	100
TOTAL		4	64	20	80	100
PART- B (PRACTICAL)						
SBI-517 (P)	Practicum-I	4	72	20	80	100
GRAND TOTAL		24	392	120	480	600

SEMESTER II

Course Code	Course Name	Credit	Teaching Hours	Internal Marks	External Marks	Total Marks
PART- A (THEORY)						
SBI-521(C)	Applied Biomechanics	4	64	20	80	100
SBI-522(C)	Statistics in Sports Biomechanics	4	64	20	80	100
SBI-523(C)	Fundamental of Simulation Technique	4	64	20	80	100
SBI-524(C)	Sports Training	4	64	20	80	100
TOTAL		16	256	80	320	400
ELECTIVE (Choose any one)						
SBI-525 (E)	Sports Psychology	4	64	20	80	100
SBI-526 (E)	Sports Injuries & Rehabilitation	4	64	20	80	100
TOTAL		4	64	20	80	100
PART- B (PRACTICAL)						

SBI-527 (P)	Practicum-II	4	72	20	80	100
GRAND TOTAL		24	392	120	480	600

SEMESTER III

Course Code	Course Name	Credit	Teaching Hours	Internal Marks	External Marks	Total Marks
PART- A (THEORY)						
SBI-531(C)	Mechanical Aspects of Biomechanics	4	64	20	80	100
SBI-532(C)	Biomechanical Analysis of Human Movement	4	64	20	80	100
SBI-533(C)	Dynamics of Gait	4	64	20	80	100
SBI-534(C)	Instrumentation in Sports Biomechanics	4	64	20	80	100
TOTAL		16	256	80	320	400
ELECTIVE (Choose any one)						
SBI-535(E)	Dissertation*	4	64	20	80	100
SBI-536(E)	Yoga	4	64	20	80	100
TOTAL		4	64	20	80	100
PART- B (PRACTICAL)						
SBI-537(P)	Practicum-III	4	72	20	80	100
GRAND TOTAL		24	392	120	480	600

SEMESTER-IV

Course Code	Course Name	Credit	Teaching Hours	Internal Marks	External Marks	Total Marks
PART-A THEORY						
SBI-541(C)	Biomechanical Analysis of Athletic and Team Games	4	64	20	80	100
SBI-542(C)	Sports Analytics	4	64	20	80	100
SBI-543(C)	Clinical Biomechanics	4	64	20	80	100
SBI-500(C)	Dissertation (including Research Work Done in Previous Semesters)	4	64	20	80	100
TOTAL		16	256	80	320	400
PART- B (PRACTICAL)						
SBI-544(P)	Practicum-IV	4	72	20	80	100
PART-C (INTERNSHIP)						

SBI-545(I)	Internship	4	72	20	80	100
GRAND TOTAL		24	400	120	480	600

**MASTER OF SCIENCE SPORTS BIOMECHANICS
(2020 onwards)**

CUMULATIVE CHART

SEMESTERS	Assessment Pattern			Teaching Hours		Total Credits
	Internal Marks	External Marks	Total Marks	Theory Hours	Practical Hours	
I	120	480	600	320	72	24
II	120	480	600	320	72	24
III	120	480	600	320	72	24
IV	120	480	600	256	144	24
GRAND TOTAL	480	1920	2400	1216	360	96

SEMESTER-I

Paper-I: Introduction to Sports Biomechanics (SBI-511 (C))

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 Sports technique
- 1.3 Goals of Sports Biomechanics – Performance Enhancement, Technique, Equipment, Training, Injury Prevention and Rehabilitation
- 1.4 Elementary Trigonometry
 - 1.4.1 Definition of Trigonometry
 - 1.4.2 Pythagoras Theorem
 - 1.4.3 Trigonometric Ratios in right triangles
 - 1.4.4 Problems related to skill

Unit – II

2. Linear and Angular Kinematics

- 2.1 Linear Kinematic
Quantities: Distance and Displacement, Speed and velocity, Acceleration, Vectors and scalars, 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 Inertia
- 3.2 Mass
- 3.3 Force (Internal and External)
- 3.4 Momentum
- 3.5 Friction and its types
- 3.5 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. Basic Concepts: Forms of Motion

- 4.1.1 Linear Motion
- 4.1.2 Angular Motion
- 4.1.3 General Motion
- 4.2 Concept of Relative Motion
- 4.3 Newton's Law of Linear Motion

Recommended Books:

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. McGinnis, 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)

Paper-II: Fundamentals of Anatomy and Kinesiology SBI-512 (C)

Learning Objective:

- Gain the ability to recognize and understand the basic structure and classification of Joint and Muscles
- Develop an Understanding of Auxiliary and Fundamental Movements
- Basic Magnification of Kinesiological Concept in the movement mechanism

Unit-I

1. Introduction of Anatomy

- 1.1 Concept of Anatomy
- 1.2 Cell, Tissues and its classification
- 1.3 Bone and its Type
- 1.4 Joint and its Classification
- 1.5 Fundamental Movements around Joints
- 1.6 Anatomical Position
- 1.7 Planes and Axis

Unit-II

2. Basics of Muscle

- 2.1 Structure of Skeletal Muscle
- 2.2 Structural and Functional Classification of Muscle
- 2.3 Muscle fiber and its Type
- 2.4 Classification of Muscular Contraction
- 2.5 Mechanism of Muscular Contraction

Unit-III

3. Kinesiological Concept

- 3.1 Concept of Kinesiology
- 3.2 Auxiliary Movements in Joints
- 3.3 Anatomical Lever and its Types
- 3.4 Two Joint Muscle, Angle of Pull
- 3.5 All and None Law
- 3.6 Reciprocal Innervations

Unit-IV

4. Steps of Kinesiological Analysis

- 4.1 Anatomical Analysis
- 4.2 Mechanical Analysis
- 4.3 Kinesiological Analysis
- 4.4 Mechanism of muscle fibre Atrophy
- 4.5 Prescription for improvement

Recommended Books:

1. Bourne, Geoffrey H. The Structure and Function of Muscle: London: Academic Press (1973)
2. Guyton, Arthur C. Text book of Medical Physiology (Philadelphia: W.B Saunders Company, 1976)
3. James C. Clouh, Fundamental of Human Anatomy (Lea and Fibiger, Philadelphia, 1971)
4. Mathew, D.K and Fox E.L, Physiological Basis of Physical Education and Athletics (Philadelphia: W.B Saunders Company, 1976) 7TH Edition
5. Pears Evelyn C. Anatomy and Physiology for Nurses (London: Faber & Faber Ltd. 1929)
6. Waurika, Roger and Williams, Peter L. Gray's Anatomy (London: Longmans Group Ltd. 1973)

PAPER-III: Research Methodology in Sports Science (SBI-513 (C))**Unit -I**

- 1.1 Basic concept of Research, types and Steps of Research
- 1.2 Methods of research
- 1.3 Hypothesis: Meaning, Basis, Types, Testing of hypothesis-
- 1.4 Type I Error, Type II Error, One Tailed Test and Two Tailed Test.

Unit- II

- 2.1 Sampling: Population, Sample, Sampling Techniques-
 - 2.1.1 Probability Sampling and Non- Probability Sampling,
 - 2.1.2 Size of sample and Sampling Error.
- 2.2 Variables and its classification.
- 2.3 Review of literature: Sources, types and importance.
- 2.4 Research Tools: Characteristics, Types, Selection of appropriate tool
- 2.5 Construction and Standardization of tools-Reliability, Validity and Norms.

Unit-III

- 3.1 Experimental Designs
- 3.2 Ethical issues in research
- 3.3 Areas of scientific dishonesty
- 3.4 Ethical issues regard copyright
- 3.5 Scientific Misconduct

Unit-IV**Research Report and proposal**

- 4.1 Salient features of Proposal
- 4.2 Basic guidelines of Research Report
- 4.3 Research Reports
- 4.4 Parts of research report
- 4.5 Thesis and Dissertation Format

Recommended Books:

1. Barrow, H. M. (1979). Practical Approach to Measurement in Health & Physical Education. (3rd ed.). Philadelphia: Lee & Febigeer

2. Clark, D. H. & Clark, H. H. (1979). Research process in Physical Education, recreation & health. Englewood Cliffs: prentice Hall.
3. Johnson, B. & Christensen, L. (2008). Education Research, Quantitative, Qualitative and Mixed Approaches. (3rd ed.). Sage Publication: England.
4. Miller, David. K. (2002). Measurement by the Physical Educator. New York: McGraw Hill companies. John & Nelson (1998). Practical Measurements for Evaluation in Physical Education. Delhi: Surjit Publication.
5. Sprinthall, R. C. (1997). Basic statistical Analysis. (5th ed.). USA: Allyn & Bacon
6. Thomas, J. R. & Nelson, J. K. (2001). Research Methods in Physical Education, (4th ed.). USA: Human Kinetics.

Paper-IV: Measurement and Evaluation in Sports Science (SBI-514 (C))

Unit-I

1. Introduction

- 1.1 Meaning of Test Measurement and Evaluation
- 1.2 Relationship among Test, Measurement & Evaluation
- 1.3 Principles of Evaluation
- 1.4 Need of Test Measurement and Evaluation
- 1.5 Formative and summative evaluation

Unit-II

2. Selection of Construction of Tests

- 2.1 Criteria of Test Selection
- 2.2 Factors Affecting Scientific Authenticity
- 2.3 Procedure to establish Scientific Authenticity
- 2.4 Construction of Test – Knowledge Test & Skill Tests
- 2.5 Guidelines for constructing objective and subjective test
- 2.6 Administration of testing program, its procedure and follow up

Unit-III

3. Measurement of Fitness Test

- 3.1 Indiana Motor Fitness Test
- 3.2 AAHPER youth fitness test
- 3.3 Kraus Weber Fitness Test
- 3.4 Test Component of Physical & Motor Fitness test
- 3.5 Measurement of Health Related Fitness
- 3.6 Measurement of IOWA Posture
- 3.7 Anthropometric Measurements: Method of Measuring Height: Standing Height, Sitting Height.

Unit-IV

4. Tests of Sports Skills

- 4.1 AAHPERD Volleyball Test, Russell & Lung test, AAHPERD Basketball, Johnson test, Soccer Sozi test & Johnson test, Miller Wall Volley test, Lockhort & McPherson Test, Harbans Singh Hockey Test
- 4.2 Physiological Testing: Aerobic Capacity: The Bruce Treadmill Test Protocol, 1.5 Mile Run test for college age males and females.
- 4.3 Anaerobic Capacity: Margaria-Kalamen test, Wingate Anaerobic Test,
- 4.4 Method of measuring Circumference: Arm, Waist, Hip, Thigh. Method of Measuring Skin folds: Triceps, Sub scapular, Suprailiac.

Recommended Books:

1. Barrow M: Hareld and Mc Ghee, Rosemary A Practical Approach to Measurement in Physical Education. (Philadelphia Lea nadFebhiger, 1979).
2. Bosco S. James and Gustafson F. Willian, Measurement and Evaluation in Physical Education in Physical Fitness and Sports (New Jersey: Englewood Cliffs, Prentic Hall 1983).
3. Clarks, H. David and Clarke Hnson. H. Application of Measurement to Physical Education (Englewood Cliffs. Prentice Hall Inc., 1987) Edn.6
4. Hubbard W. Alfred (D) Research Method in Health, Physical Education and Recreation 3rd revised edition (Washington: D.C. American, Association of Health Physical Education and Recreation.
5. Johnson L. Barry: and Nelson K. Jack, Practical Measurement for Evaluation in Physical Education 1st Indian Reprint, (Delhi: Surjeet Publication, 1982 ed. 3rd.
6. Larson L.A. and Yown R.C. Measurement and Evaluation in Physical Health and Recreation Education (St. Louis L.C.V. Mosby Com 1957.)
7. Larson, L.A. Encyclopedia of Sport of Sport Sciences and Medicine Education and Recreation 3rd Revised Edn. (Washinton D.C. American (Association of Health, Physical Education and Recreation, 1973).
8. Mathews, Donald K. Measurement in Physical Education (London W.B. Saunders Co. 1973) Edn. 5
9. Philips D. Allen and Honard E. James Measurement and Evaluation in Physical Education, New York: Wiley and Sons, 1973.

Paper –V Sports Physiology (SBI-515 (E))

Learning Outcome

- Identify the relationship between Exercise and Exercise Physiology on human performance
- Able to Describe the cause and effect of various exercises on Sports Performance
- Able to apply the knowledge of exercise and training

Unit-I

- 1.1 Meaning, Definition of Exercise & Exercise Physiology.
- 1.2 Role & Importance of exercise physiology in the field of Physical Education & Sports.
- 1.3 Impact of Exercise on work at cellular level.
- 1.4 Sliding filament theory.

- 1.5 Various changes during Muscular Contraction.
- 1.6 Fiber types their characteristics and athletic performance.

Unit-II

- 2.1 The basic energy systems (carbohydrate metabolism)
 - 2.1.1 ATP- PC system
 - 2.1.2 Glycolytic system
 - 2.1.3 Oxidative system
- 2.2 Metabolism of fat & protein and carbohydrate.
- 2.3 Neuro physiology
 - 2.3.1 Role of membrane ion channels
 - 2.3.2 Membrane potential
 - 2.3.3 Bio-electric potential
- 2.4 Electrolyte balance & Water balance

Unit-III

- 3.1 Pulmonary ventilation
 - 3.1.1 Ventilation during exercise & Rest.
 - 3.1.2 Alveolar ventilation & second wind.
 - 3.1.3 Respiratory responses to high altitude.
- 3.2 Physiological aspects of development of strength, endurance, speed, agility & coordination.
- 3.3 Cardiovascular response to exercise.

Unit-IV

- 4.1 Cardiovascular enhancers
 - 4.1.1 Blood doping
 - 4.1.2 Beta blockers
- 4.2 Effect of drugs & doping on athletic performances.
- 4.3 Diet, supplements & performance
 - 4.3.1 Diet & fluids
 - 4.3.2 Supplements & their effects
- 4.4 Exercise and training in females

Recommended Books:

1. Edward L Fox, Richard W. Bowers and Merle L. Foss, The Physiological Basis of Physical Education and Athletics. William C Brown Pub., Hardcover.
2. William D. Mc. Ardle, Frank I. Katch Victor L. Katch, Exercise Physiology: Energy, Nutrition, and Human Performance. Fifth Edition, Lippincott Williams and Wilkins, Philadelphia.
3. Jack H. Wilmore, David L. Costill and W. Larry Kenney, Physiology of Sport and Exercise. Fourth Edition, Human Kinetics, Campaign.
4. W. Larry Kenney, Jack H. Wilmore and David L. Costill, Physiology of Sport and Exercise, Fifth Edition, Human Kinetics, Campaign.

5. Robert A. Robergs and Scott O. Roberts, Fundamental Principles of Exercise Physiology: For Fitness, Performance, and Health. McGraw-Hill College, New York.
6. Scott O. Roberts, Robert A. Robergs, and Peter Hanson, Clinical Exercise Testing and Prescription Theory and Application. William C Brown Pub., Hardcover.
7. Frank C. Mooren, Klaus Volker, Editors, Molecular and Cellular Exercise Physiology. Human Kinetics, Champaign.
8. Frank J. Cerny, Harold W. Burton, Exercise Physiology for Health Care Professionals. Human Kinetics, Champaign.
9. Sharon A. Plowman, Exercise Physiology for Health, Fitness, and Performance. Lippincott Williams & Wilkins, Philadelphia.
10. Gene M. Adams, Exercise Physiology: Laboratory Manual. McGraw-Hill Higher Education, New York.
11. Jie Kang, Bioenergetics Primer for Exercise Science. Human Kinetics, Champaign.
12. Stephen S. Cheung, Advanced Environmental Exercise Physiology. Human Kinetics, Champaign.
13. Thomas Reilly, Sport, Exercise and Environmental Physiology. Elsevier Churchill, Livingstone.
14. Jay Hoffman, Physiological Aspects of Sport Training and Performance. Human Kinetics, Champaign.
15. Tommy Boone, Ethical Standards and Professional Credentials in the Practice of Exercise Physiology. Edwin Mellen Press, Hardcover.
16. Tommy Boone, Exercise Physiology: Professional Issues, Organizational Concerns, and Ethical Trends. Edwin Mellen Press, Hardcover.

Practical Paper-I (SBI-517 (P))

1. Basic anthropometric Measurements (Stature, Sitting height, Length of Segments, Width of Joints and Girth Measurement)
2. BMI and Skin Fold Measurements
3. Manual testing of Major Muscles of the Body
4. Stick Diagram (Fundamental Movement & Advance Technique of Various Sports)
5. Calculation of Range of Motion with the help of Protractor
6. Manual calculations of various kinetic and kinematic parameters – Distance, Displacement, Speed, Velocity, Acceleration, Momentum, Force, Mass, Weight, Resultant Vector, Pressure, Work, Power, Energy etc.
7. Conversion of Angular velocity in various units (Degree, Radian, Rotation)
8. Goniometry – Measurement of Joint ROM
9. Practical of Basic Biomechanical Concept in Newton's Law of Motion, Moment of Inertia, Lever

SEMESTER-II

Paper-I Applied Biomechanics SBI-521 (C)

Learning Outcome:

- Ability to Analyse the movement in view of Newtonian Mechanics
- Able to Describe the force resolution in varied situation of sports
- Gain the knowledge of Biomechanical Model

Unit – I

1 . Linear and Angular Kinetics of Human Movement

1.1 Linear Kinetics

1.1.1 Newton's Laws of Motion: First, Second & Third Laws

1.2.1 Application of Linear Newton's law in Sports Skill

1.2 Angular Kinetics

1.2.1 Angular Analogues of Newton's Laws of Motion: First, Second & Third Laws

1.2.2 Application of Angular Newton's law in Sports Skill

1.2.3 Centripetal and Centrifugal Force

1.2.4 Factors Affecting Centripetal and Centrifugal Force

Unit-II

2. Energy, Work and Power

2.1 Concept of Mechanical Energy

2.2 Forms of Energy

2.2.1 Kinetic Energy

2.2.2 Potential Energy

2.2.3 Strain Energy

2.3 Conservation of Mechanical Energy

2.4 Concept of Work and Power

2.5 Relationship between Work and Energy

Unit-III

3. Force

3.1 Force System and Its Resultant

3.1.1 Collinear Forces

3.1.2 Concurrent Forces

3.1.3 Parallel Forces

3.2 Resolution of Forces

3.2.1 Graphical Method

3.2.2 Trigonometric Method

3.2.3 Mathematical Problems

Unit-IV

4. Biomechanical Model

- 4.1 Link – Segment Model Development
- 4.2 Force Acting on the Link Segment Model
- 4.3 Joint Reaction Forces and Bone on Bone Forces
- 4.4 Steps to Develop Biomechanical Model

Recommended Books:

1. Efficiency of Human Movement by MarrionBroer, W.B. Saunders company
2. Analysis of Human motion a textbook in kinesiology. M. Gladys scott. Appleton- century-crofts Inc., N. York.
3. Sports Biomechanics. Reducing injury and Improving performance, Roger Battlett, Taylor and Francis, London and N. York.
4. Kinesiology Scientific Basis of Human Motion K. Luttgens and K.F. Wells., Saunders College publishing, N. York.

PAPER-II: Statistics in Sports Biomechanics SBI-522 (C)

Learning Objectives: To understand Research Methods, Processing & Presentation of Data & Analysis Techniques using software programme.

Learning Outcome: Enables students to Learn Scientific Methods, Statistical Analysis Techniques Using Software Programmes and Manually.

Unit -I

1. Basic concepts of Statistics and Parameter
2. Parametric and Non- Parametric Statistics
3. Different Statistical Techniques

Unit -II

1. Parametric Statistics: One way ANOVA, Two ways ANOVA
2. One way ANCOVA
3. Correlation: Regression Analysis, Assumptions, Calculation, and Interpretation.

Unit -III

1. Non- Parametric Statistics: Chi-Square, Mann Whitney U Test, Assumptions, Calculation, and Interpretation.

Unit-IV

1. Statistical Software Package: Preparations of data file: Types of data, defining variables and its properties, data entry validating data. Installing and

starting the statistical package. Computations of descriptive statistics and its interpretation

Unit-V

1. Computing Statistical Techniques using the software: Prepare the correlation matrix and compute partial and multiple correlations, Regression analysis with step and step down methods, Application of t, F and Z tests, one and two way Analysis of variance, Chi Square tests

Recommended Books:

2. Jerry R Thomas & Jack K Nelson (2000) Research Methods in Physical Activities; Illonosis; Human Kinetics;
3. Kamlesh, M. L. (1999) Reserach Methodology in Physical Education and Sports, New Delhi
4. Rothstain A (1985) Research Design and Statistics for Physical Education, Englewood Cliffs: Prentice Hall, Inc
5. Sivaramakrishnan. S. (2006) Statistics for Physical Education, Delhi; Friends Publication
6. Garrett ,H.E (2000) Statistics in Psychology and Education, Hyderabad: International Book Bureau
7. J. P. Verma(2012) Using SPSS: An Interactive Hands - On Approach, Sage South Asia
8. J. P. Verma(2015) Repeated Measures Design for Empirical Researchers, Wiley-Blackwell
9. Dutta N.K. Fundamentals of Bio-Statistics. 2002; Kanishka Publishers, New Delhi.
10. Gupta S.P. Statistical Methods. 2004; S. Chand & Sons, New Delhi
11. Ruud H. Koning and James H. Albert (2008) Statistical thinking in sports. Chapman & Hall/CRC, Taylor & Francis Group

PAPER-III: Fundamentals of Simulation Technique SBI-523 (C)

Learning Outcome:

- Able to describe the computer application in sports as simulation technique
- Describe the features of Model Development
- Able to develop the model of various Sports techniques.

Unit-1

1. Introduction to Simulation Technique
 - 1.1 Concept of Simulation Technique
 - 1.2 Meaning of Inverse Dynamics
 - 1.3 Meaning of Forward Dynamics
 - 1.4 Concept of Rigid Body and Elastic Structures

Unit-II

2. Model Building
 - 2.1 Basics of Model Building
 - 2.2 Components of Model Building

- 2.3 Muscle Models- Contractile and elastic Component
- 2.4 Process of Building Simulation Model

Unit-III

- 3. Evaluation and Application of Model
 - 3.1 Parameter Determination
 - 3.2 Model Evaluation
 - 3.3 Issue in model Design
 - 3.4 Application of Model In sports

Unit-IV

- 4. Modeling of Basic Skills
 - 4.1 Model Features of Aerial Movement, High Bar in Gymnastic , Vaulting
 - 4.2 Model Features of Tumbling , Spring Board Dive , Drop Landing
 - 4.3 Model Features of Triple Jump, Vertical Jump
 - 4.4 Model Features Running Jumps for Height and Distance

Recommended Books:

1. Albro, J.V., Sohl, G.A., Bobrow, J.E. and Park, F.C. 2000. On the computation of optimal high-dives. In Proceedings of the IEEE Conference on robotics and automation
2. San Francisco, CA. Allen, S.J., King, M.A., Yeadon, M.R. 2010. Is a single or double arm technique more advantageous in triple jumping? Journal of Biomechanics
3. Allen, S.J., King, M.A. and Yeadon, M.R. 2012. Models incorporating pin joints are suitable for simulating performance but unsuitable for simulating internal loading. Journal of Biomechanics
4. Allen, S.J., King, M.A. and Yeadon, M.R. 2013. Tradeoffs between horizontal and vertical velocities during triple jumping and the effect on phase distances. Journal of Biomechanics (in press).
5. Bobbert, M.F., Houdijk, J.H.P., Koning, J.J. de, Groot, G. de 2002. From a one-legged vertical jump to the speed-skating push-off: A simulation study, Journal of Applied Biomechanics.
6. Brewin, M.A., Yeadon, M.R., Kerwin, D.G. 2000. Minimising peak forces at the shoulders during backward longswings on rings, Human Movement Science
7. Caldwell, G.E. 2004. Muscle modeling, in G.E. Robertson, G.E. Caldwell, J. Hamill, G. Kamen, S.N. and Whittlesey (eds) Research Methods in Biomechanics (eds), Champaign, IL: Human Kinetics.

PAPER-IV: Biomechanical Applications in Sports Training SBI-524 (C)

Unit-I

1. Scientific basis of Sports Training, Importance, Aims and Objectives of Sports Training; Characteristics of Sports Training;

- 1.1. Biological Process in Sports Training; Components of Physical Fitness (motor abilities) –Endurance, Strength, Speed, Flexibility, Coordination; Agility
- 1.2. Resistance Training and Spotting Techniques – Equipment: Body Weight Exercises, Free Weights, Variable Resistance Machines, Isokinetic Equipment
- 1.3. Exercise and Spotting – Technique, Upper Body Exercises, Lower Body Exercises, Explosive Lifts

Unit-II

2. Principles of Sports Training - Overload, Specificity, Progression and Reversibility
 - 2.1. Meaning and concept of Training load
 - 2.2. Adaptation and Recovery
 - 2.3. Super Compensation
 - 2.4. Training Structure - Volume, Intensity, Frequency, Peaking
 - 2.5. Errors in Training
 - 2.6. Adaptations to Aerobic, Anaerobic and Resistance Training

Unit-III

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

Unit-IV

4. Biomechanics of Resistance Exercise,
 - 4.1. Video of an athletic activity, complete analyse the exercise,
 - 4.2. Identify the muscles involved,
 - 4.3. Determine the types of contraction,
 - 4.4. Determine the range of motion with respect to plane,
 - 4.5. Determine the intensity,
 - 4.6. Estimate the velocity from the start to end of the exercise

Recommended Books:

1. Physiology of Sport and Exercise 6th Edition with Web Study Guide-Loose-Leaf Edition by W. Larry Kenney, Jack Wilmore, David Costill.
2. Periodization-6th Edition Theory and Methodology of Training by Tudor Bompa, Carlo Buzzichelli.
3. Physiological Aspects of Sport Training and Performance With Web Resource-2nd Edition, Human Kinetics By Jay Hoffman.
4. Recovery for Performance in Sport by Institut National du Sport de l'Expertise et de la Performance INSEP, Human Kinetics, Christophe Hauswirth, A. Mujika.

5. Essentials of Sports Training and Conditioning by JB Learning, NASM.
6. Singh, H: Science of Sports training, DVS Publication, New Delhi, 1991.
7. Matweyev, L.P.: Fundamentals of Sports training, publication Moscow, 1984.
8. Harre, D: Principles of sports training, Sportverlag, Berlin, 1988.
9. Singh, H: Science of Sports training: General theory and methods, NIS, Patiala, 1984.
10. Scholisch, M: Circuit training, Sportverlag, Berlin.
11. Willmore, J.H.: Athletic training and physical fitness, Antro and Becon Inc, Sydney.

PAPER-V: Sports Psychology SBI-525 (E)

Learning Objective:

- To develop an understanding of the nature psychology and its factor responsible to sports performance.
- Students will come to the others factors apart from sports training psychological factors also contribute in the spots performance.

Unit -I

Introduction

- 1.1 Meaning, Importance, Relevance
- 1.2 Scope of Educational and Sports Psychology
- 1.3 General characteristics of Various Stages of growth and development
- 1.4 Types and nature of individual differences;
 - 1.4.1 Factors responsible - Heredity and environment

Unit-II

Methods of Psychological Study

- 2.1. Methods of psychological study: (Introspection method, Observation method and Experimental method)
- 2.2 Psycho-sociological aspects of Human behavior in relation to physical education and sports
- 2.3 Nature of learning, theories of learning, Laws of learning, Plateau in Learning & transfer of training

Unit-III

Personality and Sports Performance

- 3.1 Meaning and definition of personality,
- 3.2 Types and Characteristics of personality
- 3.3 Theories of Personality
- 3.4 Dimension of personality
- 3.5 Personality and Sports performance
- 3.6 Types and nature of individual differences

UNIT- IV

Motivation and Aggression in Sports

- 4.1 Motivation: Nature of motivation
 - 4.1.1 Factors influencing motivation
 - 4.1.2 Motivation and techniques; Impact on sports performance
- 4.2 Aggression and Sports: Meaning and nature of anxiety, Kinds of anxiety
- 4.3 Meaning, nature and Types of stress
- 4.4 Anxiety, Stress, Arousal and their effects on sports performance

Recommended Books:

- 2 Ball, D. W. & Loy, J. W. (1975). Sport and Social Order; Contribution to The Sociology Of Sport. London: Addison Wesley Publishing Co., Inc.
- 3 Blair, J.& Simpson, R.(1962). Educational Psychology, New York: McMillan Co. Cratty, B. J.(1968). Psychology and Physical Activity. Eaglewood Cliffs. Prentice Hall.
- 4 Kamlesh, M.L. (1998). Psychology in Physical Education and Sport. New Delhi: Metropolitan Book Co.
- 5 Loy, J. W., Kenyon, G. S. & McPherson, B. D. (1978). Sport and Social System. London: Addison Wesley Publishing Company Inc.
- 6 Loy, J. W., Kenyon, G. S. & McPherson, B. D. (1981).Sports Culture and Society. Philadelphia: Lea & Febiger.
- 7 Mathur, S.S., (1962). Educational Psychology. Agra. Vinod Pustak Mandir.
- 8 Skinnner, C. E., (1984.). Education Psychology. New Delhi: Prentice Hall of India.
- 9 William, F. O. & Meyer, F. N. (1979). A Handbook of Sociology. New Delhi: Eurasia Publishing House Pvt Ltd.

PRACTICUM-II SBI-527(P)

1. Calculation of Center of Gravity by Suspension Method
2. Determination of center of gravity of human body under resting and working conditions.
3. Correctly identify and label the composition, structure and types of bone using skeletal models.
4. Differentiate accurately between palpating tendon, muscle, bone, artery and nerve.
5. Properly demonstrate and instruct the osteo kinematic movements of the body -flexion, extension, rotation etc.
6. Analyze precisely a given functional activity by joint angle, joint movements and muscle activity.
7. Analyze accurately activities based on the center of gravity and base of support of a person.
8. Identify accurately and palpate the structures, bones and bony landmarks of the upper and lower extremities.
9. Prepare a description of a selected motor skill, breaking it down into component phases and identifying starting and ending points.

SEMESTER-III

PAPER-I: Mechanical Aspects of Biomechanics SBI-531 (C)

Learning Outcome

- Identify the relationship between kinematic and kinetic as they relate to the human performance
- Able to describe the cause and effect of various mechanics on Sports Performance
Able to apply the knowledge of Fluid Mechanics

Unit-I

1. Linear and Angular Kinematics of Human Movement

- 1.1. Linear Kinematics of Human Movement:
- 1.2. Acceleration: Average and Instantaneous
- 1.3. Equations of Uniformly accelerated motion
- 1.4. Vector: Vector Addition, Head to tail method, Parallelogram Method
- 1.5. Relationship between Linear and Angular Kinematics of Human Movement
- 1.6. Linear and Angular Displacement, Linear and Angular Velocity, Linear and Angular Acceleration

Unit – II

2. Projectile & Spin

- 2.1. Horizontal and Vertical Components
- 2.2. Factors Influence projectile trajectory
- 2.3. Projection Angle, Projection Speed, Relative Projection Height
- 2.4. Spin: Concept of Spin
- 2.5. Types of Spin
- 2.6. Magnus Force
- 2.7. Effect of Spin on Bounce

Unit – III

3. Linear Kinetics of Human Movement

- 3.1. Conservation of Momentum
- 3.2. Impact and Elasticity
- 3.3. Elastic Collision, Inelastic Collision
- 3.4. Coefficient of Restitution
- 3.5. Concept of Impulse
- 3.6. Relationship between Impulse and Momentum

Unit-IV

4. Fluid Mechanics

- 4.1. Flotation- Center of Buoyancy
- 4.2. Relative Motion
- 4.3. Types of Drag - Surface Drag, Form Drag, Wave Drag, Lift and its Coefficient

Recommended Books:

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)

PAPER-II: Biomechanical Analysis of Human Movements SBI-532 (C)

Learning Outcome:

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

Unit-I

1. Methods of Analysis Human Movement

1.1 Qualitative Analysis

1.1.1 Pre Requisite Information

1.1.2 Basic Step of Observation Method

1.1.3 Identification of Faults

1.2 Quantitative Analysis

1.2.1 Creation of Model

1.2.2 Video Recording with Accuracy

1.2.3 Vertex Digitization

1.2.4 Draw Trajectory of Vertex

1.2.5 Stick Figure

1.3 Predictive Analysis

Unit-II

2. Mechanical Analysis of Locomotion

2.1 Walking

2.2 Running

- 2.3 Jumping
- 2.4 Hopping or Leaping

Unit-III

- 3. Mechanical Analysis of giving motion to external objects in everyday tasks and sports
 - 3.1 Pulling
 - 3.2 Throwing
 - 3.3 Hitting
 - 3.4 Kicking
 - 3.5 Stroking

Unit-IV

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

Recommended Books:

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

PAPER-III: Dynamics of Gait SBI-533 (C)

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Recommended Books:

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

PAPER-IV: Instrumentation in Sports Biomechanics SBI- 534 (C)

Learning Outcome:

- Acquainted Knowledge about Sophisticated Instruments used in the field of sports Biomechanics
- Learn the mechanism of working of Equipment and their Application in varied indoor and outdoor events
- Able to interpret the data in relation to the sports

Unit-I

1. Force and Pressure Measurement

- 1.1 Basic Terminology Used in Electrical Instrumentation
- 1.2 Types of Force Platforms
 - 1.2.1 Strain gauge Transducer Based Platform –Strain Gauge Sensor, Platform Construction
 - 1.2.2 Piezoelectric Transducer Based Platform-Pizeoelectric Effect, Platform Construction
- 1.3 Application of the Force Platform- Walking, Running and Take-off Ability
- 1.4 Gait Analysis
- 1.5 Pod metric Platform

Unit-II

2. Electromyography

- 2.1 Basics of Surface EMG recording
- 2.2 Procedure of Data Collection and Normalization
- 2.3 Types of Signal Processing in Electromyography (EMG)
- 2.4 Use of Electromyography in Sports Skill

Unit-III

3. Sports Analysis

- 3.1 Radar gun, Doppler Effect
- 3.2 Accelerometer and its Types
- 3.3 Dynamometer, Isokinetic Dynamometry
- 3.4 Goniometer and its Application

Unit-IV

4. Motion Analysis

- 4.1 Video Camera features
- 4.2 Basic Concept of Motion Analysis
- 4.3 2D Motion analysis and its procedure.
- 4.4 3D Motion Analysis and its Procedure
- 4.4 Basicsof Motion Analysis Software

Recommended Books:

1. Jerry N. Barham, Kinesiology analysis the C.V. Mosby Company Saint Louis 1978.
2. Analysis of Human motion a textbook in kinesiology. M. Gladys scott. Appleton-century-crofts Inc., N. York.
3. Efficiency of Human Movement by MarrionBroer, W.B. Saunders company
4. Hall, Susan J. Basic Biomechanics, Fourth Edition (Boston etc.:WCB/MC Graw-Hill Companies, 2004)
5. Hay, James G. The Biomechanics of Sports Techniques, Fourth Edition (Englewood cliffs, New Jersey; Prentice Hall, 1993)
6. Hay, James G. and Raid J. Gavin, Anatomy, Mechanics and Human motion, Second Edition (Englewood cliffs, New Jersey: Prentice Hall, 1988).
7. Kreighbaum, Ellen and Barthels. Biomechanics – A qualitative Approach for studying Human movement. Third edition (New York:MC Milan publishing company, 1990)
8. Winter A. David 1979:Biomechanics of Human Movement John Wiley and Sons, Inc USA

ELECTIVE PAPER

PAPER-V Dissertation SBI- 535 (E)

PAPER-VI Yogic Science SBI-536 (E)

Learning Outcome:

- Acquainted knowledge about application of yoga
- Learn the various asanas and pranayama
- Able to go through yoga practices and meditation

Unit-I

1. Introduction and Evolution of Yoga
 - 1.1 Meaning, Definitions & Historical background of Yoga.
 - 1.2 Evolution of Yoga and contribution of famous Yogi's.
 - 1.3 Aims & Objectives of Yoga Education.
 - 1.4 Application & Misconception about Yoga in Modern Society.

Unit-II

2. Introduction to Yoga and Yogic Text
 - 2.1 Introduction to different schools of Yoga.
 - 2.2 Concept of Chakras, Panchkosh, Panchprana and Aura in Yoga.
 - 2.3 Essence of Veda & Upnishad, according to Yogic Granth.
 - 2.4 Yoga according to Maharshi Patanjali.

Unit-III

3. Introduction to various practices according to Hath Yoga and Gheranda Samhita
 - 3.1 Asanas - Meaning, Definitions, Types, Techniques, Precautions and benefits.
 - 3.2 Pranayama-Meaning, Definitions, Types, Techniques, Precautions and benefits.
 - 3.3 Shatkarma – Meaning, Types (Dhauti, Basti, Neti, Trataka & Kapalabhati) techniques, Precautions and Benefits.
 - 3.4 Mudras & Bandas – Meaning, Technique, Precautions and Benefits.

Unit-IV

4. Introduction to Yoga & Mental Health
 - 4.1 Indian and Western approach to personality development through Yoga.
 - 4.2 Attitude change through Yogic Practices.
 - 4.3 Mental relaxation through Prayer – A cross-cultural approach to mental health.
 - 4.4 Yoga Meditation: Meta Physical and Therapeutic perspective.

Practical

1. Students should prepare a case study in the field of Yoga and Allied Area.
2. Yogic counseling techniques.
3. Recitation of various mantras.
4. Strategies for relaxing body and mind.
5. Various techniques of meditation (Musical, Omkar, Trataka etc.)
6. Prepare a note on institutions offering various courses in Yoga Education.

Recommended Books:

1. Satyanand Saraswati Swami (2006), Four Chapter of Freedom. Yoga Publications Trust, Munger, Bihar, India.
2. Satyanand Saraswati Swami (2013), Asanas, Pranayama Mudra Bandha. Yoga Publications Trust, Munger, Bihar, India.

3. Iyengar, B.K.S., "Light on the Yoga" Haper Collins Publications India, Pvt. Ltd., New Delhi.
4. Krishna Rama (1998), "A Matter of Health (Integration of Yoga and Western Medicine for Prevention and Cure)", Chennai East West Books, Madras Pvt. Ltd.
5. Tiwari, O.P. (1984), Asanas – Why and How, Kailvalyadham, Lonavala, 410403, India.
6. Kuvalyananda Swami (1985), Asanas, Oriental Longaman Ltd., I., Asafali Road, New Delhi.
7. Bhogal, R.S. (2010), Yoga & Mental Health & Beyond, Kaivalyadhama SMYM Samiti; 1 edition.

PRACTICAL -III SBI-537 (P)

1. Classification of Various movements in Axes and Planes
2. Classification of Segmental Movements
3. Surface Marking of Major Bone Parts
4. Surface marking of origin and insertion of Major muscles of the body
5. Identification of Joint of Upper and Lower Extremity by Palpation Method
6. Calculation of Horizontal and Vertical components of Projectile
7. Different types of Camera; Features of Camera; Position of Camera (Height, Tripod, Light, Frame Per Second, Shutter Speed, Pixel, Resolution etc)
8. Demonstration of Coefficient of Restitution
9. Calculation of Force using Force platform
10. Application of Ergometer
11. Baropodometric Platform

SEMESTER-IV

PAPER-I: Biomechanical Analysis of Athletics and Team Games 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. History, legends, world record, skills, technique, application of biomechanical principles and analysis, analysis of current world and Olympic record holder's performance.
 - 1.1. Types of Crouch Start – Bunch start-Medium start Elongated start
 - 1.2. Running – Stride length - Take-off distance - Flight distance - Landing Distance – Stride Frequency - Action of leg - Supporting phase-Driving phase - Recovery phase - Action of arms -Action of trunk –
 - 1.3. Finish - Types of Finish - Start - Running – Finish
 - 1.4. Spikes – Types of spikes
 - 1.5. Hurdles– High hurdles-Approach, take- off- Flight- Landing- Running between hurdles-

Unit-II

2. Throws (Shot-put, hammer, discus and javelin) technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance.
 - 2.1. Shot-put - Shot-put - O'Brien style-Initial stance-Glide-Delivery-Reverse - Rotation style-distance prior to release Physique-Position-Distance after release-Height of release-Speed of release-Forces exerted -Angle of release – Air resistance - Advantages and Disadvantages of O'Brien and Rotation techniques.
 - 2.2. Hammer - Hammer Throw – Preliminary swing-The first turn-The second turn-The third turn-The delivery-Air resistance Speed of release, Angle of release-Height of release.
 - 2.3. Discus - Discus Throw – Initial stance –Preliminary swings-Transition-TurnDelivery-reverse-Aerodynamic factors.
 - 2.4. Javelin Throw – Types of Grip –Carry- Run – Transition, Throw, and Recovery-Speed, Angle, Height of release Aerodynamic factors influencing flight- Advantages and Disadvantages of different Grips-Aerodynamic Javelin.

Unit-III

3. Jumps technique, application of biomechanical principles, analysis of related research reviews, and analysis of current world and Olympic record holder's performance.
 - 3.1. Long Jump-Hang style - Hitch Kick style - Approach run – Take-off -Flight in the Air - Landing –Take-off distance-Flight distance, Speed, angle, height of take off-air resistance-Advantages and Disadvantages of different styles.
 - 3.2. Triple Jump - Hop - Step and Jump- Approach Run – Take-off - Flight in the Air – Landing

Unit IV

4. Basketball, Volleyball, Badminton, hockey, football, cricket, boxing, gymnastics, cycling and swimming
 - 4.1. History of the game, skills and technique, application of biomechanical principles, analysis of skills related each games and sports.

Recommended Books:

1. Hay, J. (1993). The Biomechanics of Sports Techniques, Benjamin Cummings.
2. McGinnis, Peter M. Biomechanics of Sport and Exercise, Human Kinetics, 2005.
3. Clarke, David H. Clarke, Harrison H. Research Process in Physical Education, New Jersey: Prentice Hall Inc. 1984.
4. Jerry R. Thomas, Jack K. Nelson and Stephen J. Silverman., Research Methods in Physical Activity (5th Ed), Human Kinetics
5. Chris Gratton and Ian Jones., Research Methods for Sports Studies, London: Routledge, Taylor & Francis Group, 2004.
6. John W. Best and James V. Kahn., Research in Education (9th Ed.), New Delhi: Prentice Hall of India Pvt. 2006.
7. Robertson .E Gordon D et al. Research Methods in Biomechanics. New York: Human Kinetics. 2004

PAPER-II: Sports Analytics SBI-542 (C)

Learning Outcome:

- Able to understand the role of Analytics in different Sports provide a deeper insight into the current status of sports Analytics
- To know the importance of Analytics for athletes, coaches, referees, managers and viewers.

Unit-1

1. Introduction of Sports Analytics
2. Concept of Sports Analytic
3. Understanding of sports Data
4. Creating performance matrix for players and athletes
5. Forecasting and prediction

Unit-II

1. Multidimensional Approach
2. Analytical Principles and techniques Review
3. Sports Data Visualization
4. Player Valuation
5. Profit or loss Analysis in sports

Unit-III

1. Tools for Sports Analytics
2. Conditional Probability, Conditional Expectation
3. Random Variables and Probability Distribution
4. Hypothesis Testing
5. Prediction based on Regression

Unit-IV

1. Application of Sports Analysis
2. Markov Model
3. Massey's Method and Colley's Method
4. Decision Tree Analysis
5. Sports Analytic model for Team Sports

Recommended Books:

1. Mathematics,(2009), Wayne Winston, Princeton University Press.
2. Benjamin Alamar ,(2013), Sports Analytics – A Guide for Coaches, Managers, and Other Decision Makers Aug 2013
3. Gil Fried, Ceyda Mumcu , (2017) Sports Analytics A data-driven approach to sport business and management, 1st Edition

PAPER-III: 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
2. Concept of Clinical Biomechanics Chiropractic Technique
3. Motion Palpation
4. Principles of Palpation Technique

Unit-II

1. Foot Mechanics in Locomotion
2. Footwear Influences on walking and Running
3. Plantar Fasciitis, Achilles Tendinopathy
4. Posterior Tibial Tendon Dysfunction
5. Lombard's Paradox

Unit-III

1. Knee clinical Mechanics
2. Knee Patellofemoral Syndrome
3. Knee Iliotibial Band Syndrome
4. Knee Ligaments and Meniscus
5. Knee Biomechanical Alteration

Unit-IV

1. Clinical Mechanics of Hip and spine
2. Hip Joint Dysfunction
3. Hip impingement
4. Clinical Biomechanics of Spinal Manipulation
5. Biomechanics of Back Pain

Recommended Books:

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

PAPER-IV: Dissertation SBI-500 (C)

Submission of the Thesis by the student and the work undertaken should be presented in PPT and VIVA VOCE should be conducted.

PAPER-V Practicum-IV SBI-544 (P)

1. Biomechanical analysis of a Fundamental technique. (Qualitative & Quantitative)
2. Use of Reflective markers, Location of Joint for placing markers
3. Field Setting during Data Collection in Motion Analysis
4. Basics of Cinematography method and Videography
5. Segmentation method (Fundamental Movement & Advance Technique of Sports)
6. Using calculation by Excel Programming for segmentation method
7. Biomechanical study of work posture, joint angle study, determination of spinal curvature, analysis of posture by video graphic method – OWAS, REBA, RULA, OCRA etc.
8. Application of G-Sensor in Various Protocols
9. Determination of gait pattern.
10. Determination of foot pressure and different position of angles.
11. Determination of Planar video analysis.
12. Determination of 2-D & 3-D motion analysis
13. Use of KINOVEA Software (Analysis of Fundamental Movement)
14. Electromyography Procedure for Static Movement & Sports Skill
15. X Sense Software

PAPER-VI: Internship SBI-545 (I)

Internship- All the students would be assigned to various centers under MYAS/University/Institutes for their training. The criteria of Internship will be provided separately.

Internship is an important component of sport psychology training that provides students with the opportunity to gain applied practical experience in the field of sport psychology. It allows a student to employ what is learned in class in a supervised environment, which is critical in order to further develop professional skills and assure quality practice. Each student admitted to the M.A. Sports Psychology course shall undergo 8 Credits (144 hours) compulsory internship programme at institutes under Ministry of Youth Affairs and Sports (MYAS). The internship programme shall be of 200 marks, out of which 100 marks shall be internal and 100 marks shall be external.

LEARNING OBJECTIVES OF INTERNSHIP:

The Masters internship would examine the implementation of curriculum based knowledge acquired by the Post Graduate Students which includes the following learning objectives:

- Theories about Biomechanics requirement and relevance for the sports and exercise participants.
- The mechanical context within which sport biomechanics is applied.
- Methods and ways to carry out studies in the sports biomechanics with which the student shall be able to reflect upon the way these methods are applied for Sport Biomechanics as a profession.
- To acquire knowledge of the challenges faced by sports biomechanics and the ways to address them.
- Talent identification and performance enhancement skills relevant for sports biomechanics.
- Assessment of sportspersons and applying intervention strategies.
- Applying rehabilitation skills on different level of sportspersons.

ASSESSMENT CRITERIA FOR INTERNSHIP SUPERVISOR:

Sr. No.	Please evaluate this student intern on the following items:	Max. Marks
1.	Arrived to work on-time	10
2.	Behaved in a professional manner	10
3.	Effectively performed Assignments	10
4.	Communication skills	10
5.	Ability to work with others and adapt to a variety of Tasks	10
6.	Decision-making, setting Priorities	10
7.	Reliability and dependability	10
8.	Willingness to ask for help and guidance	10
9.	Demonstrated critical thinking and problem solving skills	10
10.	Meeting deadlines	10
Total		100