

SCHEME OF EXAMINATION FOR M.P.ED. UNDER CBCS, 2023-24
I-Semester (2023 to 2024)
DEPARTMENT OF SPORTS BIOMECHANICS

Program outcome

- Provide mastery that allows students to acquire knowledge, skills in the physical education
- Enhance the competency of research and statistical problem in the field of physical education and enhance the quality of higher education.
- Facilitate the development of critical Observation and problem solving skills throughout the course.
- Facilitate the ability to communicate effectively and persuasively, both verbally and in writing, in leadership roles in various professional settings and work effectively with diverse groups and organizations.
- Display an understanding of the role and impact of growing and changing technologies in the field of sports biomechanics.
- Ability to demonstrate and engage technologies appropriate for use in the sport industry.

Program Specific Outcome

- Ability of kinesiological and biomechanical assessments using latest technology in the field of Sports Biomechanics.
- Development of Biomechanical model for the various fundamental movement and complex movement.
- Determine safe and effective exercise programs based on the research to achieve desired outcomes and goals.
- Establish exercise Program for prevention and rehabilitation of sports injuries.
- Handling of sophisticated equipment in real time situation in the field of Sports Biomechanics.

SCHEME OF EXAMINATION FOR M.P.ED. UNDER CBCS, 2023-24

I-Semester (2023 to 2024)

DEPARTMENT OF SPORTS BIOMECHANICS

PART-A: THEORY COURSES

Paper No.	Code	Courses	Max. Marks	Min. Pass Marks	Aggregate Pass Marks	Total Marks	Credits
I	MPEd/I/A/01	Research Methods Sessional	75 50	34 --	56	125	5
II	MPEd/I/A/02	Applied Statistics Practical Sessional	50 25 50	23 11 --	56	125	5
III	MPEd/I/A/SB/03	Anatomy of Human Movement Practical Sessional	50 25 50	23 11 --	56	125	5
IV	MPEd/I/A/ SB/ 04	Fundamental of Sports Biomechanics Practical Sessional	50 25 50	23 11 --	56	125	5
					Total	500	20

PART-B: ACTIVITY COURSE (SPORTS SPECIALIZATION)

Select one Game/Sport out of the following in the Semester-I, which to be continued till the end of Programme: (Administrative feasibility will be kept in mind while offering Game/Sport for Specialization): Athletics, Badminton, Basketball, Cricket, Football, Gymnastics, Hockey, Judo, Swimming, Table Tennis, Tennis, Volleyball, Weight Lifting and Yoga.							
I	MPEd/I/B/SB/01	Sports Theory-I Sessional	50 50	23 ---	45	100	3
II	MPEd/I/B/SB/02	Skill Proficiency-I Sessional	50 50	23 --	45	100	3
					Total	200	6

SCHEME OF EXAMINATION FOR M.P.ED. UNDER CBCS, 2023-24

II-Semester (2023 to 2024)

DEPARTMENT OF SPORTS BIOMECHANICS

Paper No.	Code	Courses	Max. Marks	Min. Pass Marks	Aggregate Pass Marks	Total Marks	Credits
I	MPed/II/A/01	Science of Sports Training Sessional	75 50	34 --	56	125	5
II	MPed/II/A/02 MPed/II/A/03 MPed/II/A/04	Optional paper (anyone) a. Sports Medicine & Athletic Care & Rehabilitation b. ICT in Physical Education c. Yogic Science Practical Sessional	50 25 50	23 11 --	56	125	5
III	MPed/II/A/ SB /05	Structural Kinesiology Practical Sessional	50 25 50	23 11 --	56	125	5
IV	MPed/II/A/ SB /06	Biomechanics of Human Movement Practical Sessional	50 25 50	23 11 --	56	125	5
Total						500	20

Note: Towards the end of II-Semester, the students will submit Synopsis for their proposed Dissertation (Optional) in the area related to Physical Education Pedagogy for approval.

PART-B: ACTIVITY COURSE (SPORTS SPECIALIZATION - continued from Semester-I)

I	MPed/II/B/SB/01	Sports Theory-II Sessional	50 50	23 --	45	100	3
II	MPed/II/B/SB/02	Skill Proficiency-II Sessional	50 50	23 --	45	100	3
Total						200	6

SCHEME OF EXAMINATION FOR M.P.ED. UNDER CBCS, 2024-25

III-Semester (2024 to 2025)

DEPARTMENT OF SPORTS BIOMECHANICS

PART-A: THEORY COURSES

Paper No.	Code	Courses	Max. Marks	Min. Pass Marks	Aggregate Pass Marks	Total Marks	Credits
I	MPed/III/A/01	Fitness & Wellness Practical Sessional	50 25 50	23 11 --	56	125	5
II	MPed/III/A/02 MPed/III/A/03 MPed/III/A/04	Optional paper (any one) a. Adapted Phy.Edu. b. Gender and Inclusive Education c. Sports Journalism Sessional	75 50	23 --	56	125	5
III	MPed/III/A/ SB/ 05	Mechanical Aspect of Biomechanics Practical Sessional	50 25 50	23 11	56	125	5
IV	MPed/III/A/ SB/ 06	Analysis of Human Movement Practical Sessional	50 25 50	34 11	56	125	5
Total						500	20

Note: The students will start their Dissertation work (optional) as approved by the Committee.

PART-B: ACTIVITY COURSE(SPORTS SPECIALIZATION–Selected one game/ Sport in the semester – I to be continued:

II	MPed/III/B/ SB/ 01	a. Coaching Lessons Sessional b. Internal Internship (15 Days)	50 50 100	23 45	90	200	5
Total						200	5

SCHEME OF EXAMINATION FOR M.P.ED. UNDER CBCS, 2024-25

IV-Semester (2024 to 2025)

DEPARTMENT OF SPORTS BIOMECHANICS

PART-A: THEORY COURSES

Paper No.	Code	Courses	Max. Marks	Min. Pass Marks	Aggregate Pass Marks	Total Marks	Credits
I	MPEd/IV/A/01	Optional paper (any One) a. Exercise Physiology	50	23	56	125	5
	MPEd/IV/A/02	b. Sports Psychology Practical	25	11			
	MPEd/IV/A/03	c. Dissertation Sessional	50				
II	MPEd/IV/A/04	Optional paper (any One) a. Sports Management	50	23	56	125	5
	MPEd/IV/A/05	b. Essential Educational Technology	25	11			
	MPEd/IV/A/06	c. Health Education Practical Sessional		50			
III	MPEd/IV/A/ SB/ 07	Instrumentation in Biomechanics Practical Sessional	50 25 50	23 11 --	56	125	5
IV	MPEd/IV/A/ SB/ 08	Biomechanical Analysis of Sports Skill Practical Sessional	50 25 50	23 11 --	56	125	5
Total						500	20

Note:- In the absence of getting passing marks in the sessional, the result shall be withheld.

PART-C: THEORY TEACHING PRACTICE

I	MPEd/IV/C/ SB/ 01	Classroom Teaching Sessional	100 100	45	90	200	5
Total						200	5
Grand Total						2800	102

**SEMESTER WISE DISTRIBUTION OF MARKS (CBCS)
2023-24 and 2024-25**

Term	Compulsory Paper (Credits)	Optional Paper (Credits)	Sports Specialization (Credits)	Class Room Teaching (Credits)	Total Marks (Credits)
Sem. I	500 (20)	--	200 (06)	--	700 (26)
Sem. II	375 (15)	125 (05)	200 (06)	--	700 (26)
Sem. III	375 (15)	125 (05)	200 (05)	--	700 (25)
Sem. IV	250 (10)	250(10)	--	200 (05)	700 (25)
Total	1525 (60)	375 (20)	650 (17)	150 (05)	2800 (102)

M.P.Ed. 2023-24
GUIDELINES FOR SESSIONAL MARKS
FORMATIVE EVALUATION (as per CBCS)

For Theory Courses

1.	Assessment within class	-	20	Marks
2.	Class Test I	-	25	Marks
3.	Class Test II	-	25	Marks
4.	Assignment	-	20	Marks
5.	Attendance	-	10	Marks
				100
				Marks

For Activity Courses (Sports Specialization)

1.	Assessment within class	-	20	Marks
2.	Class Test I	-	25	Marks
3.	Class Test II	-	25	Marks
4.	Assignment	-	20	Marks
5.	Attendance	-	10	Marks
				100
				Marks

NOTES:

- Each Theory Course shall have 4 Units and 3 hrs. duration final examination except Sports Specialization which will have 3 units each in semester I and II and 2-hour duration semester-end examination at the end of both semesters.
- The pattern of Semester-end question papers shall be:
 - For papers having Max. Marks- 75** : [15+15+15+15+(3x5)=75 marks]
Each question paper shall consist of 9 questions (2 long answer questions from each unit and 1 combined question of 8 short notes from all 4 units). The candidate will attempt any one question from each unit (4 questions of 15 marks each from first 8 questions). The 9th question will be compulsory consisting 8 short notes of 3 marks each. The candidate will attempt any 5 short notes.
 - For papers having Max. Marks- 50** : [10+10+10+10+(2x5)=50 marks]
Each question paper shall consist of 9 questions (2 long answer questions from each unit and 1 combined question of 8 short notes from all 4 units). The candidate will attempt any one question from each unit (4 questions of 10 marks each from first 8 questions). The 9th question will be compulsory consisting short notes of 2 marks each. The candidate will attempt any 5 short notes.

2.3. **For papers having Max. Marks- 50 (For Sports Specialization):** [10+10+10+(4x5)=50 marks]

Each question paper shall consist of 7 questions (2 long answer questions from each unit and 1 combined question of 8 short notes from all 4 units). The candidate will attempt any one question from each unit (3 questions of 10 marks each from first 6 questions). The 7th question will be compulsory consisting short notes of 4 marks each. The candidate will attempt any 5 short notes.

3. If any student misses any Mid Semester or Class Test due to "On Duty", a supplementary test shall be conducted by the teacher concerned, but, only after confirming his/her "On Duty". It shall be the sole responsibility of the concerned 'On Duty' student to contact the teacher and complete his test/s. No supplementary test/s shall be conducted for any other reason or absence (like Medical Leave or Personal Leave etc.). However, if any student was on leave due to any exigency, the HOD and/or the Vice Chancellor will have the discretion to permit such student to appear in supplementary of Mid semester Examination.

SEMESTER WISE DISTRIBUTION OF MARKS (CBCS)

Term	Compulsory Paper	Optional Paper	Sports Specialization	Class Room Teaching	Total Marks
Sem. I	500 (20)	--	200 (06)	--	700 (26)
Sem. II	375 (15)	125 (05)	200 (06)	--	700 (26)
Sem. III	375 (15)	125 (05)	200 (05)	--	700 (25)
Sem. IV	250 (10)	250 (10)	--	200 (05)	700 (25)
Total	1500 (60)	500 (20)	550 (15)	250 (07)	2800 (102)

Anatomy of Human Movement

Learning Outcome:

- **Know the concept of basic Human movement.**
- **Able to interpret the mechanics of bone, ligament and muscle.**
- **Knowledge about basics structure of human structure in terms of mechanics**

UNIT-I

1. Neuromuscular Basis of Human Movement

1.1 Motor unit

1.1.1 Concept of motor unit

1.1.2 Types of motor unit

1.2 Gradation in the strength of muscular contraction

1.2.1 Recruitment order

1.2.2 Rate Coding

1.3 Sensory receptors

1.3.1 Motor control in sports

UNIT-II

2. Mechanics of Bone

2.1 Composition and structure of Bone tissue

2.2 Growth and development of Bone

2.2.1 Longitudinal and circumferential growth

2.2.2 Adult bone development

2.2.3 Bone Atrophy

2.2.4 Epiphyseal Injuries

2.3 Bone response to stress

2.3.1 Bone modeling and remodeling

UNIT-III

3. Mechanics of skeletal muscle

3.1 Muscle size and its force production

3.2 Relationship between force production and contraction velocity

3.3 Relationship between force production and fiber type

3.4 Adaptation of muscle to prolonged length changes

UNIT-IV

4. Human Skeletal Articulations

4.1 Joint Architecture

4.2 Articular cartilage, Fibrocartilage and connective tissue

4.3 Joint stability

4.3.1 Shape of articulating bone surfaces

4.3.2 Arrangement of Ligament & Muscles.

4.3.3 Other connective tissues

4.4 Joint flexibility

4.5 Technique of increasing joint flexibility

Practicals

1ST SEMESTER

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)
5. Calculation of Range of Motion with the help of Protractor

References:

1. The Biophysical Foundations of Human Movement, Bruce Abernethy human Human Kinetics 1997, USA
2. Astrend, P.O. and Rodahl Karee, Text Book of Work Physiology, Tokye: McGraw – Hill Kogakusha Ltd.
3. Bourne, Geoffery H. The Structure and Function of Muscles: London: Academic Press (1973)
4. Caprovich, P.V. and Sinning. Wayne E. Physiology of Muscular Activity (Philadelphia: W.B. Saunders, 1976), 7th Edition.
5. Chaurasia B.D. Human Anatomy Regional and Applied (CBS Publishr and Zdistributors, 1979)
6. Guybon, Arthur C. Text Book of Medical Physiology. (Philadelphia: W.B. Saunder Company, 1976)
7. James C. Clouch, Fundamental Human Anatomy (Lea & Febiger, Philadelphia, 1971)
8. Mathew, D.K. and Fox E.L., Physiological Basis of Physical Education and Athletics (Philadelphia: W.B. Saunders Company, 1976)
9. Morehouse, I.E. Miller, A.T. Physiology of Exercise. (St. Louis: The C.V. Mosby Compnay, 1976) 7th Edition.
10. Pears evelyr C. Anatomy and Physiology for Nurses (London: Faber & Faber Ltd. 1926)
11. Perrot J.W. Anatomy for Students and Physical Education (London: Adward Arnold and Co. 1976)
12. St. John's Ambulance, First-Aid By Red-Cross Society of India.
13. Waruida, Roger and Williams, Peter L. Gray's Anatomy (London: Longmans Group Ltd. 1973).

Fundamental of Sports Biomechanics

Learning Outcome:

- **Develop knowledge and understanding of sports biomechanics.**
- **Able to differentiate between kinematics and kinetics**
- **Knowledge about basics of fluid mechanics and its application**

UNIT-1

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
 - 1.4.1 Definition of Trigonometry
 - 1.4.2 Pythagoras Theorem
 - 1.4.3 Trigonometric Ratios in right triangles
 - 1.4.4 Problems related to skill
- 1.5 Basic Concepts: Forms of Motion
 - 1.5.1 Linear Motion
 - 1.5.2 Angular Motion
 - 1.5.3 General Motion

Unit – II

2. Linear and Angular Kinematics

- 2.1 Linear Kinematic
Quantities: Distance and Displacement, Speed and velocity, Acceleration, Vectors and scalars
- 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

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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 Center of gravity and its uses
- 3.2.5 Moment of Inertia.

Unit –IV

4. Fluid Mechanics:

- 4.1 Flotation
- 4.2 Relative Motion
- 4.3 Fluid Resistance: Air & Water
- 4.4 Drag & Lift

Practicals

1ST SEMESTER

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. Conversion of Angular velocity in various units (Degree, Radian, Rotation)
3. Goniometry – Measurement of Joint ROM
4. Practical of Basic Biomechanical Concept in Newton's Law of Motion, Moment of Inertia, Lever
5. Calculation of Center of Gravity by Suspension Method.

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)

Structural Kinesiology

Learning Objective:

- **Understanding of structural kinesiology and reference system**
- **Develop an Understanding of muscle mechanics**
- **Basic Magnification of Kinesiological analysis of joints and Basic exercise**

UNIT-I

1. Introduction to kinesiology and structural Kinesiology

- 1.1 Concept of kinesiology and structural Kinesiology
- 1.2 Planes of motion & Axes of rotation
- 1.3 Reference positions of Musculoskeletal system
- 1.4 Features of Bones
 - 1.4.1 Bone Properties
 - 1.4.2 Bone Growth
 - 1.4.3 Bone Markings

UNIT-II

2. Muscle Mechanics

- 2.1 Muscle Terminology & Determination of Muscle Action
- 2.2 Functional Classification/Roles of Muscle
- 2.3 Neuromuscular concepts
 - 2.3.1 Angle of Pull
 - 2.3.2 All or None Law
 - 2.3.3 Reciprocal Innervations
 - 2.3.4 Two Joint Muscle Biarticular and Multiarticular Muscles**
 - 2.3.5 Active and Passive insufficiency**

UNIT-III

3. Muscular analysis of Upper extremities

3.1 Origin and Insertion of Major Muscles of upper extremities

- 3.1.1 Shoulder Girdle and Shoulder Joint
- 3.1.2 Elbow Joint
- 3.1.3 Wrist Joint

3.2 Analysis of upper body exercises

- 3.2.1 Shoulder Pull
- 3.2.2 Arm curl
- 3.2.3 Triceps extension
- 3.2.4 Bench press
- 3.2.5 Latissimus Pull
- 3.2.5 Push-Up

UNIT-IV

4. Muscles analysis of Lower extremities

4.1 Origin and insertion of Major Muscles of Lower extremities

- 4.1.1 Hip Joint
- 4.1.2 Knee Joint
- 4.1.3 Ankle Joint

4.2 Analysis of Lower body exercises

- 4.2.1 Squat
- 4.2.2 Dead Lift
- 4.2.3 Rowing exercises
- 4.2.4 Bent knee sit up

Practicals

2nd SEMESTER

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

References:

- ❖ Broer, M.R. Efficiency of Human Movement (Philadelphia: W.B. Saunders Co., 1966)
- ❖ Bunn, John W. Scientific Principles of Coaching (Engle wood cliffs : N.J. Prentice Hall Inc., 1966)
- ❖ Cooper, John M. and Glassgow, R.B. Kinesiology (St. Louis: C.V. Mosby Co., 1963)
- ❖ Duvall, E.N. Kinesiology (Engle wood cliffs: N.J. Prentice Hall Inc., 1956)
- ❖ Hamiston, Nancy (2002), "Scientific Basis of Human Motion" Human Kinetics, New York.
- ❖ Hoffman S.J. Introduction to Kinesiology (Human Kinesiology publication In. 2005)
- ❖ Oatis A. Corol (2009), "Kinesiology, the Mechanics and Pathomechanics of Human Movement" Human Kinetics, New York NY
- ❖ Rasch and Burke, Kinesiology and Applied Anatomy (Philadelphi : Lea and Fibger, 1967)
- ❖ Scott, M.G. (2005) Analysis of Human Motion, New York.
- ❖ Thompson, Flyod (2004), "Manual of Structural Kinesiology" Mc Graw Hill, Singapore.
- ❖ Uppal A.K. Lawrence Mamta MP Kinesiology (Friends Publication India 2004)
- ❖ Wells, K.P. Kinesiology (Philadelphia : W.B. Saunders Co. 1966)

Biomechanics of Human Movement

Learning Outcome:

- Develop knowledge and understanding of mechanical concept of human movement
- Provide the concept of Projectile, spin and its application
- Knowledge about mechanical analysis of fundamental movement

Unit – I

1. Linear and Angular Kinematics of Human Movement

1.1 Linear Kinematics of Human Movement:

1.1.1 Acceleration: Average and Instantaneous

1.1.2 Equations of Uniformly accelerated motion

1.1.3 Vector

1.3.1 Vector Addition

1.3.1.1 Head to tail method

1.3.1.2 Parallelogram Method

1.2. Relationship between Linear and Angular Kinematics of Human Movement

1.2.1 Linear and Angular Displacement

1.2.2 Linear and Angular Velocity

1.2.3 Linear and Angular Acceleration

Unit – II

2. Projectile & Spin

2.1 Horizontal and Vertical Components

2.2 Factors Influence projectile trajectory

2.2.1 Projection Angle

2.2.2 Projection Speed

2.2.3 Relative Projection Height

2.3. Spin

2.3.1 Concept of Spin

2.3.2 Types of Spin

2.3.3 Effect of Spin on Bounce

Unit – III

3. Linear Kinetics of Human Movement

- 3.1 Conservation of Momentum
 - 3.1.1 Impact and Elasticity
 - 3.1.2 Elastic Collision
 - 3.1.3 Inelastic Collision
- 3.2 Coefficient of Restitution
- 3.3 Concept of Impulse
- 3.4 Relationship between Impulse and Momentum

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Unit – IV

4. Mechanical Analysis of Fundamental Motor Skills

- 4.1 Walking
- 4.2 Running
- 4.3 Jumping
- 4.4 Throwing
- 4.5 Catching
- 4.6 Pushing
- 4.7 Pulling

Practicals

2ND SEMESTER

1. Biomechanical analysis of a Fundamental technique. (Qualitative)
2. Calculation of Horizontal and Vertical components of Projectile
3. Application of G-Sensor in Various Protocol
4. Basics of Cinematography method and Videography
5. Demonstration of Coefficient of Restitution
6. Stick Diagram (Advance Technique of Various Sports)

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)

Mechanical Aspect of Biomechanics

Learning Outcome:

- Provide the knowledge of kinetics and its application in human movement
- Able to understand the concept of equilibrium, Leverage, Energy & Work
- Knowledge about force and its resolution

Unit – I

1. Linear and Angular Kinetics of Human Movement

1.1 Linear Kinetics

1.1.1 Momentum

1.1.2 Conservation of Momentum

1.1.3 Newton's Laws of Motion:

First, Second & Third Laws

1.1.4 Application of Linear Newton's law in Sports Skill

1.2 Angular Kinetics

1.2.1 Angular Momentum

1.2.2 Transfer of Angular Momentum

1.2.3 Centripetal and Centrifugal Force

1.2.4 Factors Affecting Centripetal and Centrifugal Force

Unit – II

2. Equilibrium and Leverage of Human Movement

2.1 Concept of Equilibrium, Stability and Balance

2.2 Types of Equilibrium

2.2.1 Static Equilibrium

2.2.2 Dynamic Equilibrium

2.3 Levers

2.3.1 Types of Lever

2.3.1.1 First class Lever

2.3.1.2 Second Class Lever

2.3.1.3 Third Class Lever

2.3.2 Mechanical Advantages of Lever

Unit – III

3. Energy, Work and Power

3.1 Concept of Mechanical Energy

3.2 Forms of Energy

3.2.1 Kinetic Energy

3.2.2 Potential Energy

3.2.3 Strain Energy

3.3 Conservation of Mechanical Energy

3.4 Concept of Work and Power

3.5 Relationship between Work and Energy

Unit – IV

4. Force

4.1. Nature of Force

4.2 Aspects of Forces

4.3. Composite Effects of Forces

- 4.3.1 Collinear Forces
- 4.3.2 Concurrent Forces
- 4.3.3 Parallel Forces

4.2 Resolution of Forces

- 4.2.1 Graphical Method
- 4.2.2 Trigonometric Method
- 4.2.3 Mathematical Problems

Practicals

3rd SEMESTER

1. Use of Reflective markers. Location of Joint for placing markers.
2. Field Setting During Data Collection in Motion Analysis
3. Different types of Camera; Features of Camera; Position of Camera (Height, Tripod, Light, Frame Per Second, Shutter Speed, Pixel, Resolution etc)
4. Segmentation method (Fundamental Movement)

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)

Analysis of Human Movements

Learning Outcome: -

- **Develop Knowledge and understanding of fundamental of movement analysis**
- **To understand the difference between qualitative and quantitative analysis of movements**
- **Understanding the concept of measurement system in sport biomechanics.**
- **Teach learners how to effectively apply different photography techniques in sports**
- **To provide understanding of locomotion kinematics**

UNIT-I

1. Introduction to Movement Analysis

- 1.1 Components of Movement Analysis
 - 1.1.1 Concept of Kinesiological analysis and Limitation
 - 1.1.2 Concept of Mechanical Analysis
 - 1.1.3 Concept of Biomechanical analysis
 - 1.1.4 Anatomic Analysis-Joint Analysis**

Unit – II

2. Methods of Analysis of Human Movements

- 2.1 Qualitative Analysis
 - 2.1.1 Pre Requisite Information
 - 2.1.2 Basic Step
 - 2.1.3 Observation Method
 - 2.1.4 Identification of Faults
 - 2.1.5 Instructions
- 2.2 Quantitative Analysis
 - 2.2.1 Creation of Model
 - 2.2.2 Video Recording with accuracy
 - 2.2.3 Experimental Videography Procedure
(Two dimensional recording procedure)
 - 2.2.4 Vertex Digitization
 - 2.2.5 Draw Trajectory of Vertex
 - 2.2.6 Stick Figure

UNIT-III

3. Mechanical Analysis of Locomotion.

- 3.1 Walking, Phases of walking i.e. supporting phase, restraining phase
- 3.2 Running Phases of running i.e. supporting phase, swinging phase, restraining phase
- 3.3 Difference between walking and running with respect to mechanical point of view
- 3.4 Jumping
- 3.5 Hopping or Leaping

Unit-IV

4 Kinesiological Analysis of Fundamental skill of the body

- 4.1 Sitting Position
- 4.2 Standing Position
- 4.3 Lying
- 4.4 Lifting
- 4.5 Carrying

Practicals

3rd Semester

1. Segmentation Method (Advance Technique of Sports)
2. Application of Ergometer
3. Videography Procedure for 2-D and 3-D Motion Analysis
4. Biomechanical analysis of a Sports technique. (Qualitative)

References:

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

Instrumentation in Biomechanics

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. Sports Analysis

- 1.1 Radar gun, Mechanism of Doppler Shift
- 1.2 Speedometer, Accelerometer
- 1.3 Dynamometer, Goniometer.
- 1.4 Application of Instruments in sports Analysis

UNIT-II

2. Force Measurement

- 2.1 Types of Force Platforms
 - 2.1.1 Strain gauge,
 - 2.1.2 Piezoelectric
- 2.2 Selection of a Force Plate (gait, balance, sports)
- 2.3 Gait Analysis
 - 2.3.1 Meaning and phases of gait cycle
 - 2.3.2 Temporal variables of Gait Cycle
 - 2.3.3 Types of Gait
- 2.4 Baropodometric Platform and its Features

UNIT-III

3.1 Electromyography

- 3.1.1 Meaning of Surface and Intramuscular EMG
- 3.1.2 Procedure of Surface EMG data collection
- 3.1.3 Processing Methods of electromyography (EMG) Signal
- 3.1.4 Application of Surface Electromyography in Sports Skill

UNIT-IV

4.1 Video cameras

- 4.1.1 Camera and Its Features
- 4.1.2 Types of Camera
- 4.1.3 Selection of camera/ camcorder
- 4.1.4 Motion Analysis
- 4.1.5 Procedure of 2D and 3D Motion analysis for Data Collection

(Note: The procedure and understanding of equipment may be imparted through practical.)

Practicals

4th SEMESTER

1. Baropodometric Platform
2. Calculation of foot pressure and different position of angles.
3. Electromyography Procedure for Static Movement
4. Use of KINOVEA Software (Analysis of Fundamental Movement)

References:

- ❖ Jerry N. barham, Kinesiology analysis the C.V. Mosby Company Saint Louis 1978.
- ❖ Analysis of Human motion a textbook in kinesiology. M. Gladys scott. Appleton- century-crofts Inc., N. York.
- ❖ Efficiency of Human Movement by marrion Broer, W.B. saundens company
- ❖ Hall, Susan J. Basic Biomechanics, Fourth Edition (Boston etc. : WCB/MC Graw-Hill Companies, 2004)
- ❖ Hay, James G. The Biomechanics of Sports Techniques, Fourth Edition (Englewood cliffs, New Jersey; Prentice Hall, 1993)
- ❖ Hay, James G. and Raid J. Gavin, Anatomy, Mechanics and Human motion, Second Edition (Englewood cliffs, New Jersey: Prentice Hall, 1988).
- ❖ Kreighbaum, Ellen and Barthels. Biomechanics – A qualitative Approach for studying Human movement. Third edition (New York : MC millan publishing company, 1990)

Biomechanical Analysis of Sports Skill

Learning Outcome:

- Develop knowledge and understanding of the analysis of the fundamental movement
- Methodologies used in sports and exercise biomechanics for the analysis of sports skills
- Develop the appreciation of inter-related scientific concepts and promote.
- Competencies in the field of sports and biomechanics
- To understand the difference between qualitative and quantitative analysis of sports movements

UNIT-I

1. Mechanical Analysis of Fundamental Movement

- 1.1 Pulling
- 1.2 Pushing
- 1.3 Throwing **and striking**
- 1.4 Hitting
- 1.5 Kicking
- 1.6 Lifting

Unit – II

2. Mechanical Analysis of Techniques of Track and Field Events

- 2.1 Analysis of Track Events:
 - 2.1.1 Start
 - 2.1.1.1 Standing Start
 - 2.1.1.2 Crouch Start (Bunch , Medium ,Elongated)
 - 2.1.2 Running
 - 2.1.3 Hurdling
 - 2.1.3.1 High Hurdles
- 2.2. Analysis of Techniques of Field Events
 - 2.2.1 Jumps
 - 2.2.1.1 Long Jump
 - 2.2.1.2 High Jump
 - 2.2.2 Throws
 - 2.2.2.1 Shot put
 - 2.2.2.2 Javelin throw

Unit – III

3. Analysis of Sports Skill

- 3.1 Gymnastics :
 - 3.1.1 Hand stand
 - 3.1.2 Forward roll
 - 3.1.3 Cartwheel
- 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

4.1 Basketball	:	Set shot, Lay-up shot and Pass
4.2 Tennis	:	Grip, Serve, forehand & backhand strike
4.3 Football	:	Kicking, Heading & Throwing
4.4 Hockey	:	Hitting, Stopping & Dribbling
4.5 Volleyball	:	Serving, Passing & Spiking

Practicals

4TH SEMESTER

1. Calculation of Force using Force platform
2. Electromyography of Sports Skill
3. Use of KINOVEA (Analysis of Sports Skill)
4. Procedure of 2D and 3D Motion Analysis

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)
9. Arther E. Chapman, PhD, DLC & Simon Fraser “Biomechanical Analysis of fundamental human moments.

Lakshmibai National Institute of Physical Education, Gwalior
M.P.Ed IV Semester (December 2020-April 2021)
Sports Biomechanics (Optional Paper)

Learning Outcome:

- **Develop basic concept of sports biomechanics**
- **Understanding of kinematic and kinetic term**
- **Knowledge of fluid mechanics and handling of basic equipment.**

Unit-I

1.1 Introduction:

- 1.1.1 Definition of Biomechanics & Sports Biomechanics
- 1.1.2 Importance of Biomechanics for Physical Education Teacher, Coach & Athlete

1.2 Basic Concepts: Forms of Motion

- 1.2.1 Translation
- 1.2.2 Rotation
- 1.2.3 General Motion

Unit - II

2.1 Linear Kinematics of Human Movement:

- 2.1.1 Linear Kinematics
Quantities: Distance and Displacement, speed and velocity, Acceleration, Vectors and scalars, units in Linear Kinematics
- 2.1.2 Projectiles: Factors influencing projectile trajectory

2.2 Angular Kinematics of Human Movement:

- 2.3.1 Angular Distance and Displacement
- 2.3.2 Angular Speed and Velocity
- 2.3.3 Units in angular kinematics

Unit – III

3.1 Linear Kinetics of Human Movement

- 3.1.1 Inertia
- 3.1.2 Mass
- 3.1.3 Force (Internal and External)
- 3.1.4 Momentum
- 3.1.5 Friction
- 3.1.6 Impact
- 3.1.7 Work, Power & Energy.

3.2 Angular Kinetics of Human Movement:

- 3.2.1 Eccentric force
- 3.2.2 Couple
- 3.2.3 Moment
- 3.2.4 Equilibrium
- 3.2.5 Levers
- 3.2.6 Center of gravity
- 3.2.7 Moment of Inertia.

Unit – IV

4.1 Fluid Mechanics:

- 4.1.1 Flotation
- 4.1.2 Fluid Resistance: Air & Water
- 4.1.3 Drag & lift
- 4.1.4 Spin

Practicals

1. Basic anthropometric measurements (stature, sitting height, different body segment length, weight)
2. BMI and skin fold measurements
3. Goniometry – measurement of joint ROM / Elgon
4. Stick diagram