School of Sports Sciences
Department of Sports Bio-Sciences

Proposed Syllabus for

M.Sc. in Sports Physiology

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

M.Sc. Sports Physiology

SEMESTER I (Total credits: 24)

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

SEMESTER II (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSP 201	Kinanthropometry	Core 5	4
MSSP 202	Adaptations to Exercise and Training	Core 6	4
MSSP 203	Principles and methods of Sports Training	Core 7	4
MSSP 204	Discipline Elective II	DE 2	4
MSSP 205	Discipline Elective III	DE 3	4
MSSP 206	Practicum III	P 3	2
MSSP 207	Practicum IV	P 4	2
MSSP 208	Fitness		1
MSSP 209	Societal		1

SEMESTER III (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSP 301	Essentials of Physiology in Sports	Core 8	4
MSSP 302	Physiological Support for Athletes	Core 9	4
MSSP 303	Discipline Elective IV	DE 4	4
MSSP 304	Discipline Elective V	DE 5	4
MSSP 305	Elective I	E 1	4
MSSP 306	Practicum V	P 5	2
MSSP 307	Practicum VI	P 6	2
MSSP 308	Fitness		1
MSSP 309	Societal		1

SEMESTER IV (Total credits: 24)

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

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

List of Elective papers offered by the Department

Code	Title of Course	Type of Course	Credits
MSSP 105/204/205/303/304/305	Biochemical Aspects of Health in Sports	Elective	4
MSSP 105/204/205/303/304/305	Drugs and Doping in Sports	Elective	4
MSSP 105/204/205/303/304/305	Endocrinology in Sports	Elective	4
MSSP 105/204/205/303/304/305	Essential of Molecular Biology	Elective	4
MSSP 105/204/205/303/304/305	Fatigue, Injuries and Rehabilitation	Elective	4
MSSP 105/204/205/303/304/305	Genetics in Sports Performance	Elective	4
MSSP 105/204/205/303/304/305	Health Fitness and Wellness	Elective	4
MSSP 105/204/205/303/304/305	Immunology in Sports Training	Elective	4
MSSP 105/204/205/303/304/305	Medical Biochemistry	Elective	4
MSSP 105/204/205/303/304/305	Nutritional Biochemistry	Elective	4
MSSP 105/204/205/303/304/305	Performance Evaluation and Testing	Elective	4
MSSP 105/204/205/303/304/305	Research Methodology	Elective	4
MSSP 105/204/205/303/304/305	Statistics for Sports Science	Elective	4
MSSP 105/204/205/303/304/305	Kinesiology	Elective	4

SEMESTER-I

MSSP 101 **Human Anatomy and Physiology** **Credit 4**

Unit-I

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

Unit-II

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

Unit-III

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

Unit –IV

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

Recommended Books:

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

MSSP 102 **Biomolecules and Metabolism** **Credit 4**

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Recommended Books:

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

MSSP 103 **Food and Nutrition** **Credit 4**

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Recommended Books:

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

MSSP 104 **Essentials of Sports** **Credit 4**

Unit-I

What are Play, Game and Sports? Types of sports and recreational activities, Importance of free play and organizational games, Terminology: Sports Science and Physical Education, Health Related and Motor performance Related Fitness

Unit-II

Philosophy and its need in Sports and Physical Education, Idealism, Naturalism and Pragmatism in Physical Education, Physical Education in Ancient Greek, Rome, India and Modern India. History of Olympic Games, Asian Games, SAARC Games and SAF Games, National Sports Awards, Trends and Problems in Sports Sciences and Physical Education in 21st Century.

Unit-III

Introduction to General Rules and Regulations of Selected Sports (Football, Field Hockey, Basketball, Volleyball, Cricket, Badminton, Tennis), Introduction to Playfields and Track Specifications, General Organizational Process of Sports Competitions.

Unit-IV

Health and Wellness (physical, mental, psychological, social and spiritual) and Athletics, Sports Careers: Media, Management, Performance, Coaching and other Related Areas.

Recommended Books:

- Bucher, C.A.: Foundation of Physical Education, St. Louis: The C.V. Mosby company, 1983.
- History and Philosophy of Sport and Physical Activity, Human Kinetics by R. Scott Kretchmar, Mark Dyreson, Matthew
- Liewellyn, John Gleaves, 2017. Synder and Geoh: Professional preparation in Health Education, Physical Education and Recreation.
- Barrow, H.M.: Man and Movement: Principles of Physical Education, Philadelphia Lea and Fabiger, 1977.
- Joseph, P.M.: Organisation of Physical Education, Kandivila,: Old students Association, T.I.P.E.
- Kamlesh, M.L. and Sangral, M.S. : History and Principles of Physical Education, Prakash Brothers, 1983.
- Wuest and Bucher: Foundations of Physical Education and Sports, B.I. Publications Pvt. Ltd., New Delhi.
- William, H.F.: Physical Education and Sports in Changing Society, Surjeet Publication, Delhi.

MSSP 105	**Discipline Elective I**	**Credit 4**

MSSP 106 **Practicum I** **Credit 2**

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

MSSP 107 **Practicum II** **Credit 2**

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

MSSP 108	**Fitness**	**Credit 1**

MSSP 109	**Societal**	**Credit 1**

SEMESTER-II

MSSP 201 **Kinanthropometry** **Credit 4**

Unit–I

Introduction, scope and general consideration, i.e. Application of anthropometric data in sports, Body proportions and indices, Sports specific body proportions and indices, Body mass index and its importance in sports.

Unit–II

Anthropometric Measurements and Procedures, Equipment for anthropometric measurements, Gross Body Measurements and procedures, Length of Body Parts, Measurements and procedures, Diameters of Body Parts, Measurements and procedures, Circumferences of Body Parts, Measurements and procedures, Skinfold Thickness, Measurements and procedures.

Unit–III

Physiological Maturation: Decimal Age and concept of Physiological maturity in sports. Assessment of skeletal maturity of athletes, Importance in sports and various methods to estimate body composition.

Unit-IV

Somatotyping: Introduction, Definition of Somatotyping and Classification with special reference to sports.

Recommended Books:

- Sports Anthropemetry by H.S. Sodhi, ANOVA Publication.
- Physique and Selection of Sportsmen by H.S. Sodhi and L.S. Sidhu.
- Kinanthropometry by S.P. Singh and P. Malhotra, Luna Publication, Patiala.
- Kinanthropometry by Roger Eston and Thomas Reilly, E & F.N. SPON, London.
- Skeletal Maturity by S.P. Singh, L.S. Sidhu, and J. Singh, Human Biology Publication Society, Punjabi University, Patiala.
- Genetic and Anthropological Studies of Olympic Athletes by De Garray, Louis Levine & Cater, Academic Press, London.

MSSP 202 **Adaptations to Exercise and Training** **Credit 4**

Unit-I

Cardiovascular Adaptations to Endurance and Strength Training, Hypertrophy and Cardiomyopathy in Young and Older Athletes, Heart rate training zone, Effects Of High Altitude, Sudden Cardiac Death and Exercise in Healthy Adults

Unit-II

Respiratory System Adaptations to Endurance and Strength Training, Ventilatory response to exercise and its use in sports, Ventilatory threshold, , Exercise-Induced Bronchoconstriction, Control of Breathing during exercise; The Respiratory System under Stress, respiratory systems adaptation to long-term exercise, Adaptations to systematic Training, Effects Of High Altitude.

Unit-III

Muscular Mechanisms in Aerobic Endurance Training; Muscle Molecular, Mechanisms in Strength Training, Muscle Property Changes in Strength Training,.

Unit-IV

Initial responses of the neuromuscular systems to exercise; Training Adaptation of the Neuromuscular System. Neuromuscular adaptations to Endurance training, Neural Mechanisms in Aerobic Endurance Training, Neural molecular changes in endurance training, Neural Mechanisms in Strength Training

Recommended Books:

- Roy J. Shephard and Henry S. Miller, Jr. (1999) Exercise and the Heart in Health and Disease. Marcel Dekker.
- Shephard, R.J. and Astrand, P.-0. (1992) Endurance in sport. Blackwell Science Ltd, USA.
- McArdle, W.D., Katch, F.I., Katch, V.L. (2006) Essentials of Exercise Physiology. Lippincott Williams and Wilkins, USA.
- Victor F. Froelicher, Jonathan Myers (2006) Exercise and the heart. Elsevier Inc.
- Christopher B. Cooper and Thomas W. Storer (2004) Exercise testing and interpretation- A practical approach. Cambridge University Press.
- K. Wasserman, J Hansen, D Sue, W Stringer, B Whipp, eds (2004) Principles of Exercise Testing and Interpretation, 4th edn. Lippincott Williams & Wilkins, Philadelphia, USA.
- Christopher Bell. Cardiovascular Physiology in Exercise and Sport . 1st Edition. 2008; Churchill Livingstone.
- Michael G. Levitzky. Pulmonary Physiology, 8e. 2013; Lange. The McGraw-Hill Companies.
- Denise L. Smith and Bo Fernhall (2011) Advanced cardiovascular exercise physiology. Human Kinetics.

MSSP 203 **Principles and methods of Sports Training** **Credit 4**

Unit-I

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

Unit-II

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

Unit-III

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

Unit-IV

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

Recommended Books:

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

MSSP 204	**Discipline Elective II**	**Credit 4**

MSSP 205	**Discipline Elective III**	**Credit 4**

MSSP 206 **Practicum III** **Credit 2**

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

MSSP 207 **Practicum IV** **Credit 2**

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

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

MSSP 208	**Fitness**	**Credit 1**

MSSP 209	**Societal**	**Credit 1**

SEMESTER-III

MSSP 301 **Essentials of Physiology in Sports** **Credit 4**

Unit I

The Physiology of Training: Effect on V02 Max. Performance, Homeostasis. and Strength - Principles of Training - Overload - Specificity - Research Designs to Study Training - Endurance Training and V02 Max - Training Programs and Changes In V02 Max - V02 Max: Cardiac Output and the Arteriovenous O2 Difference - Stroke Volume - ArteriovenousO2 Difference - Detraining and V02 Max

Unit-II

Hormones regulation during exercise and training, Hormonal Control of Substrate Mobilisation During Exercise - Muscle-Glycogen Utilisation - Blood Glucose Homeostasis During Exercise - Hormone-Substrate Interaction – Thermoregulation during exercise

Unit-III

Cardiovascular system and exercise, Pulmonary system and exercise, Neuromuscular system and exercise, Training the anaerobic and aerobic energy systems, Measurement of muscular strength-Isometric muscle testing, Eccentric muscle testing

Unit-IV

Endurance Training: Effects on Performance and Homeostasis - Biochemical Adaptations and the Oxygen Deficit - Biochemical Adaptations and the Plasma Glucose Concentration - Biochemical Adaptations and Blood pH - Biochemical Adaptations and Lactate Removal - Endurance Training: Links Between Muscle and Systemic Physiology - Physiological Effects of Strength Training , Muscular Enlargement - Concurrent Strength and Endurance Training

Recommended Books:

- Physiology of Sport and Exercise 6th Edition with Web Study Guide-Loose-Leaf Edition by W. Larry Kenney, Jack Wilmore, David Costill.
- Physiological Aspects of Sport Training and Performance With Web Resource- 2nd Edition, Human Kinetics By Jay Hoffman
- Exercise Physiology: Theory and Application to Fitness and Performance 10th Edition By Scott Powers and Edward Howley 2018.
- Exercise Physiology: Nutrition, Energy, and Human Performance 8th Edition by William D. McArdle, Frank I. Katch, Victor L. Katch
- Laboratory Manual for Exercise Physiology 2nd Edition. With Web Study Guide, Human Kinetics by G. Gregory Haff, Charles Dumke, 2018.
- A Textbook of Sports & Exercise Physiology by Dey Swapan Kumar, Jaypee Publishers
- Practical ECG for Exercise Science and Sports Medicine by Greg Whyte, Sanjay Sharma, Human Kinetics, 2010
- Physiological Tests for Elite Athletes 2nd Edition by Australian Institute of Sport Rebecca Tanner, Christopher Gore, 2012.
- ACSM's Guidelines for Exercise Testing and Prescription, 10th Edition by American College of Sports Medicine. Wolters Kluwer, 2017
- Recovery for Performance in Sport by Institut National du Sport de l'Expertise et de la Performance INSEP, Human Kinetics, Christophe Hausswirth, A. Mujika
- A Textbook of Sports & Exercise Physiology by Swapan kumar Dey, Jaypee brother, 2012.

MSSP 302 **Physiological Support for Athletes** **Credit 4**

Unit-I

Concept of athlete support, Athlete development stages - child, pre-adolescent, adolescent and adult. Human growth and development. Age related development in performance. Concept of talent in sports. Talent identification.

Unit-II

Physiological testing of athletes Maximal aerobic capacity- Explanation of result, its implication in sports, Training intensity and improvement in VO2max , Limitations of assessing VO2max, Indirect assessment of VO2max- Multi-stage shuttle run test, Cooper test, Queens College Step test. Submaximal aerobic test- Astrand nomogram, PWC 170.Assessment of strength- Dynamometers, 1repitition maximum (1RM). Assessment of dynamic strength; Assessment of muscular endurance; Assessment of flexibility; Assessment of anaerobic power- Mergaria power test, de Bruyn Prevost test; Wingate test-Peak power output, Relative peak power output, Anaerobic fatigue, Anaerobic capacity/power. Running based Anaerobic Sprint Test (RAST)- Maximum power, Minimum power, Fatigue index. Peak lactate and its importance- Talent selection and transfer of talent, Changes of lactate peak during season, Lactate peak and training,
Unit

Unit-III

Athlete Monitoring And Analysis, Time-motion analysis in sport; analysis of athlete tracking systems; GPS and accelerometer analysis of training and competition; monitoring and analysis of sport-specific physical and psychological variables; physiological monitoring; external sources of data relating to sports performance; reliability of data and sources. The use of performance indicators in performance analysis

Unit-IV

Feedback based analysis of performance, Sport-specific notational systems; computerized notational analysis; notation in individual sports; notation in team sports; augmented feedback through video-based technologies; modelling of competitive sport; analysis of structures of sports informing performance indicators; flowcharts and presentation models of sports performance; reliability and validity of notational data; data processing; probability analysis; literature searching; critical evaluation of literature

Recommended Books:

- ACSM's Guidelines for Exercise Testing and Prescription, Edition 10 by American College of Sports Medicine
- Advanced Fitness Assessment and Exercise Prescription 8th Edition by Ann Gibson, Dale Wagner, Vivian Heyward, Human Kinetics, 2018
- Principles of Exercise Prescription by V Bhutkar Milind, Jaypee Publishers
- Physiology of Sport and Exercise 6th Edition with Web Study Guide-Loose-Leaf Edition by W. Larry Kenney, Jack Wilmore, David Costill.
- Principles of Manual Therapy (A Manual Therapy Approach to Musculoskeletal Dysfunction) by Sebastian Deepak, Jaypee Publishers
- Physiological Tests for Elite Athletes 2nd Edition by Australian Institute of Sport Rebecca Tanner, Christopher Gore, 2012
- Measurement and Evaluation in Human Performance 5th Edition, Human Kinetics by James Morrow Jr., Dale Mood, James Disch, Minsoo Kang, 2016
- Laboratory Manual for Exercise Physiology 2nd Edition. With Web Study Guide, Human Kinetics by G. Gregory Haff, Charles Dumke, 2018.
- Therapeutic Exercise- Foundations & Techniques by Carolyn Kisner & Lynn Allen Colby, Jay Pee Brothers, New Delhi.
- Pollock's Textbook of Cardiovascular Disease and Rehabilitation by JL Durstine, HK

MSSP 303	**Discipline Elective IV**	**Credit 4**

MSSP 304	**Discipline Elective V**	**Credit 4**

MSSP 305	**Elective I**	**Credit 4**

MSSP 306 **Practicum V** **Credit 4**

- Blood Pressure Measurements: Effects of Body Position, Dynamic Exercise and Isometric Contractions on BP
- Resting Metabolic Rate Determinations: Predicting and Measuring RMR
- Determination of VO2max by direct and indirect method.
- Assessment of Peak lactate, lactate tolarence, lactate clearance.
- Determination of anaerobic threshold.
- Assessment of EMG and ECG.
- Oxygen Deficit and EPOC Evaluations
- Submaximal Exercise Testing: Submaximal Bench Step Test, Submaximal Treadmill Test, Submaximal Cycle Ergometer Test
- Pulmonary Function Testing: Lung Volumes and Capacities, Pulmonary Function

- MMT for Major Muscle Groups of the body
- Use of Body Composition Software
- Use of Fitness Related Software
- Exercise Prescription and Counselling for Weight Management
- Demonstration of ROM Exercises and Prescription
- Measurement of heart rate and blood pressure during and after exercise.(each student is expected to practice measurement on 50 volunteers and determine intra experimenter and inter-experimenter variation)
- Cardio-pulmonary resuscitation practice on Human Mannequin
- Aerobic power measurement using Queens' college test, Astrand-Rhyming test.
- Tests for anaerobic power (Wingate Test)

MSSP 308	**Fitness**	**Credit 1**

MSSP 309	**Societal**	**Credit 1**

SEMESTER-IV

MSSP 401	**Discipline Elective VI**	**Credit 4**

MSSP 402	**Elective II**	**Credit 4**

MSSP 403	**Dissertation**	**Credit 16**

MSSP 404	**Fitness**	**Credit 1**

MSSP 405	**Societal**	**Credit 1**

Discipline Electives

S.No.	Title of the Course
1.	**Biochemical Aspects of Health in Sports** Unit-I Concept of Health and Disease, Lifestyle and Disease, Connection between Physical Activity and Health, Exercise and Its Benefits and hazards Unit-II Biochemical Basis of Health Hazards and Benefits of Physical Activity, Biochemical Basic of Health Problems in Athletics, Biomarkers in Sports and Exercise, Tracking Health, Performance, and Recovery in Athletes. Unit-III Biochemical Basis of General Medical Issues For Athletes- Respiratory System, Cardiovascular System, Gastrointestinal system Unit-IV Neurological, Muscular System, Overtraining Syndrome, Unusual Fatigue, Dry or Sticky Mouth, Eating Disorders, Sports Injuries, Sports Specific Health Issues. **Recommended Books:** • Functional Biochemistry in Health and Disease, Eric A. Newsholme and Tony R. Leech (2010) Willey-Blackwel,

	ISBN:978-0-471-931652. • Elaine C. S. Fragala A. M. Luke Douglas J. Casa (2017) Biomarkers in Sports and Exercise: Tracking Health, Performance And Recovery in Athletes. The Journal of Strength and Conditioning Research, 31(10)/2920–2937. • Medical Conditions in the athlete, Katie Walsh and Micki Cuppett (2017) Human Kinetics, ISBN:978-1-4925-3350. • Health and Elite Sports, Joe Baker, Parisa Safai, Jessica Fraser-Thomas (2015) Routledge, ISBN:978-0-415-70866-1.
2.	**Drugs and Doping in sports** Unit I The Evolution of Doping and Antidoping In Sports, Prevalence of Doping in Sports, Doping Control in Sports, Inadvertent Use of Prohibited Substances in Sports, Role of Athlete Support Personnel in Preventing Deliberate and Inadvertent Use of Prohibited Substances, Unit II Introduction to Pharmaco-kinetics and dynamics. Different types and Methods of Doping and Masking, Anabolic Androgenic Steroids, Stimulants, Glucocorticoids, Peptide - Protein Hormone, Beta-2 Agonists, Hormone and Metabolic Modulators, Narcotics, Beta Blockers, Manipulation of Blood and Blood Components, Chemical and Physical Manipulations, Gene Doping, Diuretics and Masking. Unit III Substances and Methods Permitted in Sports, Sport Supplements and Herbal Preparations, Evolving Issues Concerning Drug Use in Sports, Athletic Testing, Analytical Procedures, And Adverse Analytical Findings, The Future of Performance Enhancing Substances in Sports, Anti-doping Movement. Unit –IV WADA and NADA Rules and Regulations Regarding Inadvertent Use of Prohibited Substances. **Recommended Books:** • Anthony C Hackey (2017) Doping, Performance-Enhancing Drugs, and Hormones in Sports ISBN:978-0-12-813442-9. • David R. Mottram, Neil Chester (2018) Drugs in Sports, Routledge, ISBN:1351838989. • Portefield, Jason (2008) Doping: athletes and drugs, Rosenn Publishing, New York, ISBN:1-4042-1917-5.
3.	**Endocrinology in Sports** Unit-I Hormonal Response to Exercise; Exercise and Endogenous Opiates; The Effect of Exercise on the Hypothalamo—Pituitary—Adrenal Axis; Impact of Chronic Training on Pituitary Hormone Secretion in the Human; Unit-II Exercise and the Growth Hormone—Insulin-Like Growth Factor-1 Axis; Thyroid Function and Exercise; The Male and female Reproductive System, Exercise, and Training; Hormonal Regulations of the Effects of Exercise on Bone; The Role of Exercise in the Attainment of Peak Bone Mass and Bone Strength; Unit-III Exercise and the Hypothalamus; Exercise Training in the Normal Female; Adrenergic Regulation of Energy Metabolism; Hormonal Regulation of Fluid Homeostasis During and Following Exercise Unit-IV Interrelationships Between Acute and Chronic Exercise and the Immune and Endocrine Systems; The Effects of Altitude on the Hormonal Responses to Exercise; Physical Activity and Mood; Hormones as Performance-Enhancing Drugs **Recommended Books:** • Warren, Michelle P., and Naama W. Constantini, eds. Sports endocrinology. Vol. 23. Springer Science & Business Media, 2000. • Lanfranco, Fabio, and Christian J. Strasburger, eds. Sports Endocrinology. Karger Medical and Scientific Publishers, 2016. • Constantini, Naama, and Anthony C. Hackney, eds. Endocrinology of physical activity and sport. New York: Humana Press, 2013.
4.	**Essentials of Molecular Biology** Unit-I History and scope of molecular biology- Discovery of DNA- evidence for DNA as the genetic material. The genomes of bacteria, viruses, plasmids, mitochondria and chloroplast- Gene transfer in microorganisms- conjugation- transformation, transduction - protoplasmic fusion. Unit-II

	Organisation of eukaryotic genome- components of eukaryotic chromatin and chromosome structure- DNA-supercoiling - linking number. Unit-III DNA replication- eukaryotic DNA replication, mechanism of replication. Enzymes and necessary proteins in DNA replication. DNA Repair- Mismatch, Base-excision, Nucleotide-excision and direct repair DNA recombination- Homologous, site-specific and DNA transposition Unit-IV Transcription- eukaryotic Transcription- RNA polymerases general and specific transcription factors- regulatory elements- mechanism of transcription regulation- Transcription termination. **Recommended Books:** • Watson. J. D, Baker. T. A, Bell. S. P, Gann. A, Levine. M, Losick. R. Molecular Biology of Gene. 6th The Benjamin / Cummings Pub. Co. Inc, 2008 • Lehninger's Principles of Biochemistry, sixth Edition, 2009 Publisher: W. H. Freeman; 6th edition | ISBN: 071677108X • Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Publishing Inc, 2000. • Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter.Molecular biology of the Cell. 4th ed. Garland publishing Inc, 2002 • Benjamin Lewin. Gene VII. Oxford University Press, Nelson Cox.
5.	**Fatigue, Injuries and Rehabilitation** Unit-I Concept of Overloading, Overtraining, Fatigue and Staleness, Symptoms and Causes of Fatigue, Types of Fatigue, Theories associated with Fatigue, Definition, Types, Symptoms, Findings, Underlying Mechanisms of Overtraining and Overtraining Syndrome. Unit II Oxygen Debt Theory, Recovery Oxygen Uptake, Excess Post-exercise Oxygen Consumption (EPOC), Implications of EPOC for Exercise and Recovery, Optimal Recovery From Steady-Rate Exercise and Non–Steady-Rate Exercise, Intermittent Exercise and Recovery Unit-III Sports Injury- Meaning, Classification, Causes, Types, General guidelines for their Prevention, Recovery Time, Introduction and Management of common Sports Injuries (Fracture, Dislocation, Laceration, Abrasion, Sprain and Strain), How to avoid Sports Injuries, Role of Warm-up and Cool Down Unit-IV Rehabilitation: Meaning, Concepts, Objective and scope of Rehabilitation**,** Principal of care and Rehabilitation Therapeutic Modalities: Electrotherapeutic modalities (Shortwave Diathermy**,** Ultra Sound**,** T.E.N.S**),** Heat and Cold, Soft tissue Massage**,** Aquatic Rehabilitation Exercise, Therapeutic Exercise, Therapeutic Nutrition, Psychological Rehabilitation **Recommended Books:** • Shaun Phillips (2015) Fatigue in Sport and Exercise. Routledge, NY • Therapeutic Modalities for Musculoskeletal Injuries 4th Edition, Human Kinetics by Craig Denegar, Ethan Saliba, Susan Saliba, 2016 • Essentials of Athletic injury management 10th edition by William E. Prentice, Human Kinetics. • Clinical Sports Medicine Fifth Edition by Peter Brukner, Karim Khan, McGraw-Hill Education Australia, 2016 • Principles and Practice of Therapeutic Massage by Sinha, Jaypee Publishers • Textbook of Electrotherapy by Singh Jagmohan, Jaypee Publishers • Manfred Lehmann, Carl Foster, Uwe Gastmann, Hans Keizer and Jtirgen M. Steinacker(Eds) (1997) Overload, Performance Incompetence and Regeneration In sport. Kluwer Academic / Plenum Publishers, N.
6.	**Genetics in Sports Performance** Unit I Basic Genetic Concepts, Mendelian inheritance, population genetics, Human chromosome Karyotype, Chromosome Disorders, Genome Structure and Genetic Mapping, Mitochondrial Inheritance, Unit II The Genetic Code and Genetic Alterations, DNA Injuries and Repair, Monogenic and Polygenetic Diseases, Molecular Diagnostics, Epigenetics in sports. Unit III Ethics of Genetic Testing and Research in Sport, Current Challenges and Directions to the Future, Genetic Modifications in Sports, Ethical Considerations of Genetic Manipulation in Sport, Gene Therapy and Gene Doping

	Unit IV Connecting Sports and Genetics, The Genetics of Sports Injuries and Athletic Performance, Genetic Contributors To Hypertrophic Cardiomyopathy, Chronic Traumatic Encephalopathy, Different Classes of Performance Enhancing Genetic Variants **Recommended Books:** • Bruce R. Korf and Mira B Irons (2012) Human Genetics and Genomics, WILEY-BLACKWELL • Manu L Kothari, Lopa A Mehta, Sadhana S roychoudhury, (2009) Principles of Genetics, Universities Press • Ricki Lewis (2017) Human Genetics the basics, Routledge, ISBN 978-1-138-66801-0 • Michael Posthum and Malcolm Collins (2016) Genetics and Sports, Karger Publisher • Elaine A. Ostrander, Heather J. Huson, and Gary K. OstranderGenetics of Athletic Performance (2009) Annu. Rev. • Genomics Hum. Genet. 2009.10:407–29 • Lisa M. Guth and Stephen M. Roth (2013) Genetic influence on athletic performance, Curr Opin Pediatr. 2013 • December; 25(6): 653–658. • Nicola Mafulli et al (2013) the genetics of sports injuries and athletic performance. Muscles, Ligaments and Tendons Journal, 3 (3): 173-189
7.	**Health Fitness and Wellness** Unit-I Introduction to Health: Concept of health, Lifestyle and Disease, Ageing. Unit-II Physical Activities & Fitness: Concept to Fitness, Exercise and its Principles, Health Education Recreation & Dance. Unit-III Healthy Life Style Approach: Concept of Wellness, Wellbeing, Stress Management. Unit-IV Spiritual and mental fitness-its concept - anxiety management and motivation. **Recommended Books:** • "Fitness and Wellness" : Warner W. K Hoeger and Sharvon A. Hoegor • "Fitness & Wellness concepts": Charles B. Corbina & Ruth Lindsey • "Lifetime Fitness & Wellness - A personal choice": Melvin H. Williams • Oxford Textbook of Public Health, Helen Liepman. • Sunderlal, Aadarsh, Pankaj, 2007, Textbook of Community Medicine, CBS Publishers & Distributors. • Kirch, Wilhelm, 2008, Encyclopedia of Public Health, Volume 1 & 2, Kluwer Academic Publishers. • Mary -Jane Schneider and Henrey Schneider, 2006 (2nd edition), Introduction to Public Health, Jones and Bartlett Publishers.
8.	**Immunology in Sports Training** Unit-I General Overview of Immune System, Innate and Adaptive immunity, Antigen and Antibody, B and T Cell immunity, Major Histocompatibility Complex and Antigen Presentation, Cell Mediated and Humoral Immune Response, Inflammation, Complement system, Cytokines, Chemokine, Hypersensitive reaction, Autoimmunity. Unit-II Relevance of Immune Function to Athletes, Causes of Illness in Athletes, Intensive Training & Effects on Immune Function, Allergy in Sports, Practical Guidelines on Minimising Infection Risk in Athletes. Unit-III Strategies to Limit Exercise Induced Immune Depression, Strategies to Support Immunity for Athletes, Immunological Aspects of Sport Nutrition, and Clinical Implication of Exercise Immunology. Unit-IV Immunology and Upper Respiratory Tract Infections; effects of exercise on blood leukocyte numbers , innate immune function, acquired immune function, mucosal immunity and practical guideline on minimising infection risk in athletes **Recommended Books:** • Kuby Immunology- Judith A. Owen, Jenni Punt (2013) W. H. Freeman, ISBN: 1464137846. • Basic Immunology-Abul Abbas, Andrew H. Lichtman, Shiv Pillai (2015) Elsevier, ISBN: 9780323390828. • Immunology by Fathimunisa Begum (2014), PHI Learning Private Limited, ISBN-978-81-203-4983-4. • Exercise immunology- Editors, Michael Gleeson, Nicolette Bishop, Neil Walsh, (2013) Routledge Publisher, ISBN-13: 978-0415507264. • Immunological aspects of sport nutrition. Immunology and Cell Biology, GLEESON, M., 2016., 94 (2), pp. 117-123. • Immune function in sport and exercise Michael Gleeson J Appl Physiol 103: 693–699, 2007;doi:10.1152/japplphysiol.00008.2007.

	• Clinical implications of exercise immunology, David C Nieman (2012), Journal of Sport and Health Science 1 (2012)12e17.
9.	**Medical Biochemistry** Unit –I Role of biochemistry in diagnosis of diseases. Gastrointestinal tract - Pancreatic disorders - malabsorption syndromes Hepatobiliary system - metabolism of bilirubin - cirrhosis, hepatitis, gall stones, and tumours. Excretory system - Renal function tests - renal hypertension- urinalysis for normal and abnormal constituents. Unit-II Disorders of carbohydrates metabolism in sports - Glucose level in normal blood, renal threshold, Hyper and hypoglycemia and glycosuria - intravenous and other types of glucose tolerance tests - Glycogen storage disorders. Disorders of nitrogen metabolism - Assimilation and excretion of nitrogen with reference to ammonia, urea, uric acid, creatine, creatinine. Disorders of lipid metabolism - Plasma lipoproteins, cholesterol triglycerides and phospholipids in health and diseases, ketosis, fatty liver. Unit-III Blood and coagulation - disturbances of blood clotting mechanisms - systematic analysis of hemorrhagic disorders - coagulation and prothrombin time, determination - hemoglobin-anemia - abnormal hemoglobins and their identification. Inherited disorders of metabolism: Changes occurring in Sports persons. Unit-IV Clinical Enzymology - Laboratory investigations on serum and urine for constituents (normal & abnormal) of diagnostic and prognostic importance. Plasma specific and non-Plasma specific enzymes. Endocrine system: Laboratory diagnosis and investigations related to disorders of thyroid, pituitary, adrenal cortex, adrenal medula, testes, ovaries. Case studies in sports sciences. **References books** • Harper's Review of Biochemistry - Ed By David Martin et al Lange Medical Publications 1987/Latest. • Metabolic control and disease – Ed. Roxenburg and Philip K. Bondy W.B. Saunders -Latest. • Biochemistry - A case oriented approach by Montogommoiry - CV Moshy Vo. / Latest. • Biochemistry - A functional approach by Mc Gilvery - W.B. Saunders Co., Latest. • Principles of Biochemist Vol. I and II by White Handler Smith al - Latest Edition McGraw Hill Publication. • Text book of Clinical Chemistry by Norbert Tietc – 1986 W.B. Saunders Co., Latest. • Metabolic Basis of inherited diseases by Stanbury, Wyngarden et aI, W.B. Saunders Co., Latest.
10.	**Nutritional Biochemistry** Unit-I The Biochemical Basis of Exercise and Sports, Biochemistry of Performance of Various Sporting Events- The Weightlifter, Sprinter, Middle Distance Events and The Endurance Athlete, Adaptation to Training, Effects of Detraining. Unit-II Fundamentals of Nutritional Biochemistry, Various Classes of Nutrients and Their Role in Human Body, Basics of Energy Use in Body, Daily Energy Expenditure, Basic Metabolic Rate, Unit-III Food Sources of Nutrients, Nutrient Digestion and Absorption, Nutrient Toxicities, Free Radicals and Anti-oxidants. Unit-IV Role of Nutrition in Sports Performance of Various Sports Events**,** Nutritional effect on Training Adaptation, Determining Energy Needs for Persons Involved in Various Exercise and Sports Activities, Proportion of Different Nutrients During Various Exercise/Sports, Hydration During Workouts, Dietary Recommendations for Different Sports. **Recommended Books:** • The Biochemical Basis of Sports Performance- Ronald J Maughan and Michael Gleeson (2010) Oxford University Press, ISBN:9780199208289. • Biochemistry for Sports and Exercise Metabolism- Don MacLaren, James Morton, (2011) Wiley-Blackwell Publisher, ISBN-978-0-470-09185-2. • Fundamentals of Human Nutrition- Catherine Heissler, Hilary Powers (2015) Churchill Livingstone Elsevier, ISBN:9780443069727. • Nutrition Chemistry and Biology- by Julian F. Spallholz and Mallory Boylan (1998), CRC Press, ISBN 13: 978-0849385049. • Brooks, GA; Fahey, TD; Baldwin KM/Exercise physiology: human bioenergetics and its applications/Fourth Edition/2005.
11.	**Performance Evaluation and Testing** Unit-I Introduction to Test, Measurement, Evaluation and Research, Basic concepts in Tests: Evaluation, Validity, Reliability, Objectivity and Norms, Test construction and its Organisation and Administration; Pre-test considerations: Risks

	associated and Safety considerations, ACSM guidelines for when to stop a Test, Pre-exercise test evaluations: Unit-II Test Order: Equations used to estimate aerobic power from TM protocols, Equations used to estimate aerobic power from Cycle ergometer protocols (arm and leg), Calculations used to estimate aerobic power from other variables, Unit-III Modes of testing, Muscular strength, endurance and flexibility, Body composition and Anthropometry, Balance, Agility, Coordination, Reaction time and Anaerobic power, Physical Fitness Batteries, Specific Sports Skill Tests (Soccer, Basketball, Volleyball, Hockey, Badminton, Tennis and other sports) Unit-IV Calculation of HR MAX and 85% HR max depending on protocol, Population considerations: Children, Elderly and Apparently healthy. Test protocols used for measuring the health and skill-related components of fitness, CV endurance field tests, VO2max testing, Norm tables, Maximal versus submaximal tests **Recommended Books:** • Advanced Fitness Assessment and Exercise Prescription 8th Edition with Online Video, Human Kinetics by Ann Gibson, Dale Wagner, Vivian Heyward, 2018. • Laboratory Manual for Exercise Physiology 2nd Edition. With Web Study Guide, Human Kinetics by G. Gregory Haff, Charles Dumke, 2018. • Measurement and Evaluation in Human Performance 5th Edition, Human Kinetics by James Morrow Jr., Dale Mood, James Disch, Minsoo Kang, 2016. • Physiological Tests for Elite Athletes 2nd Edition by Australian Institute of Sport Rebecca Tanner, Christopher Gore, 2012. • ACSM's Guidelines for Exercise Testing and Prescription, 10th Edition by American College of Sports Medicine. Wolters Kluwer, 2017. • Text book of Applied Measurement Evaluation & Sports Selection second edition: Dewinder K Kansal Sports & Spiritual Science Publications. • Heyward, Vivian. Advanced Fitness Assessment and Exercise Prescription, 5th ed., Human Kinetics, 2006. • ACSM's Guidelines for Exercise Testing and Prescription, 8th ed., Lippincott Williams and Wilkins, 2009. • ACSM's Health-Related Physical Fitness Assessment Manual, 3rded, 2009.
12.	**Research Methodology** Unit-I Introduction to Research in Physical Activity, Developing the Problem and Using the Literature, Presenting the Problem, Formulating the Method, Ethical Issues in Research and Scholarship Unit-II Types of Research: Socio Historical Process in Sport Studies, Philosophical Research in Physical Activity, Research Synthesis (Meta-Analysis), Surveys, Other Descriptive Research Methods, Physical Activity Epidemiology Research, Experimental and Quasi-Experimental Research, Qualitative Research, Mixed-Methods Research Unit-III Writing the Research Report: Completing the Research Process, Ways of Reporting Research, Introduction to review of literature, Evaluation of scientific literature; Tools of research- Questionnaires, opinionnaires, interviews and observation. Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response Unit-IV Organizing literature – strategies, use of software; Metaanalysis, Writing review – structuring the review, quoting/paraphrasing, the citation referencing system. Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism. **Recommended Books:** • Research Methodology: Methods and Techniques by C. R. Kothari. • ICMR. Ethical Guidelines for Biomedical Research on Human Subjects. 2006; ICMR, New Delhi. • Research Methods in Physical Activity- 7th Edition By Jerry Thomas, Jack Nelson, Stephen Silverman, Human Kinetics • Research Methods in Sport by Mark F Smith. • Research Methods for Sports Performance Analysis By Peter O' Donoghue. • Research Methods in Physical Education and Youth Sport 1st Edition by Kathleen Armour and Doune Macdonald. • Ridley, D. The Literature Review a step-by-step guide for students. 2012; Sage Publications Limited, New Delhi.
13.	**Statistics for Sports Science** Unit-I Introduction to Biostatistics, Frequency Distribution, Variable and Attribute, Line-diagram, Bar-diagram, Pie chart, Histogram, Mean, Median and Mode. Data, its types and collecting measures. Statistical processes, their importance and

uses in research.

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

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

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

Recommended Books:

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

14.

Kinesiology

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

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

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

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

Recommended Books:

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

----------End----------