

# **School of Sports Sciences**

## **Department of Sports Bio-Sciences**



### **Proposed Syllabus for**

### **M.Sc. in Sports Biochemistry**

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

# M.Sc. Sports Biochemistry

## SEMESTER I (Total credits: 24)

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

## SEMESTER II (Total credits: 24)

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

## SEMESTER III (Total credits: 24)

Code	Title of Course	Type of Course	Credits
MSSB 301	Sports and Exercise Metabolism	Core 8	4
MSSB 302	Instrumentation & Analytical Technique	Core 9	4
MSSB 303	Discipline Elective IV	DE 4	4
MSSB 304	Discipline Elective V	DE 5	4
MSSB 305	Elective I	E 1	4
MSSB 306	Practicum V	P 5	2
MSSB 307	Practicum VI	P 6	2
MSSB 308	Fitness		1
MSSB 309	Societal		1

## SEMESTER IV (Total credits: 24)

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

S.No.	Code	Title of Course	Type of Course	Credits
1.	MSSB 105/204/205/303/304/305	Biochemical Aspects of Health in Sports	Elective	4
2.	MSSB 105/204/205/303/304/305	Drugs and Doping in Sports	Elective	4
3.	MSSB 105/204/205/303/304/305	Endocrinology in Sports	Elective	4
4.	MSSB 105/204/205/303/304/305	Essential of Molecular Biology	Elective	4
5.	MSSB 105/204/205/303/304/305	Fatigue, Injuries and Rehabilitation	Elective	4
6.	MSSB 105/204/205/303/304/305	Genetics in Sports Performance	Elective	4
7.	MSSB 105/204/205/303/304/305	Health Fitness and Wellness	Elective	4
8.	MSSB 105/204/205/303/304/305	Immunology in Sports Training	Elective	4
9.	MSSB 105/204/205/303/304/305	Medical Biochemistry	Elective	4
10.	MSSB 105/204/205/303/304/305	Nutritional Biochemistry	Elective	4
11.	MSSB 105/204/205/303/304/305	Performance Evaluation and Testing	Elective	4
12.	MSSB 105/204/205/303/304/305	Research Methodology	Elective	4
13.	MSSB 105/204/205/303/304/305	Statistics for Sports Science	Elective	4

**SEMESTER-I**

**MSSB 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<sup>th</sup> 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<sup>th</sup> 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

**MSSB 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- glycolipids-sphingolipids- 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
- Biochemistry JM 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.

**MSSB 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 5<sup>th</sup> 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.

**MSSB 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.

<b>MSSB 105</b>	<b>Discipline Elective I</b>	<b>Credit 4</b>
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#### **MSSB 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.

#### **MSSB 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.

<b>MSSB 108</b>	<b>Fitness</b>	<b>Credit 1</b>
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<b>MSSB 109</b>	<b>Societal</b>	<b>Credit 1</b>
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#### **SEMESTER-II**

#### **MSSB 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 Anthropometry 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 Garraay, Louis Levine & Cater, Academic Press, London.

**MSSB 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.-O. (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.

**MSSB 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 Bompá, 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.
- Matveyev, 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.

<b>MSSB 204</b>	<b>Discipline Elective II</b>	<b>Credit 4</b>
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<b>MSSB 205</b>	<b>Discipline Elective III</b>	<b>Credit 4</b>
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<b>MSSB 206</b>	<b>Practicum III</b>	<b>Credit 2</b>
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- 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

<b>MSSB 207</b>	<b>Practicum IV</b>	<b>Credit 2</b>
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- 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, Fartlek Training Program

<b>MSSB 208</b>	<b>Fitness</b>	<b>Credit 1</b>
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<b>MSSB 209</b>	<b>Societal</b>	<b>Credit 1</b>
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### SEMESTER-III

#### **MSSB 301 Sports and Exercise Metabolism Credit 4**

##### Unit I

Historical and Future Perspectives, Development of Exercise Metabolism (The Early Years, Classic Period), Energy Sources for Muscular Activity, Skeletal Muscle Structure and Function, Muscles in Action, Metabolic Functions of key Organs during Exercise

##### Unit II

Metabolism during exercise: Anaerobic, Aerobic, Carbohydrate, Fat, Protein, Amino-Acids and Skeletal Muscle/Hepatic/Adipose tissue Metabolism.

##### Unit III

Exercise energetics - Immediate energy, short term energy, Long-term energy. Energy spectrum of exercise

##### Unit IV

Inter-Organ Communication, Contraction Induced Modulators of Gene Expression in Skeletal Muscles, Molecular Level Adaptive Responses to Exercise, Metabolic Factors in Fatigue, Metabolic Adaptations to Endurance,

#### **Recommended Books**

- Biochemistry for Sports and Exercise Metabolism- Don MacLaren, James Morton, (2011) Wiley-Blackwell Publisher, ISBN 978-0-470-09185-2
- The Biochemical Basis of Sports Performance- Ronald J Maughan and Michael Gleeson (2010) Oxford University Press, ISBN:9780199208289
- Exercise Metabolism- Mark Hargreaves, Lawrence L. Spriet (2006) Human Kinetics, ISBN:978-0-7360-4103-4 (AVAILABLE IN GOOGLE BOOKS).

#### **MSSB 302 Instrumentation & Analytical Techniques Credit 4**

##### Unit I

Methods of sample preparation Chromatographic techniques – General principle; adsorption and partition chromatography. Techniques and application of paper, column, thin layer, normal phase and reverse phase - ion-exchange chromatography, exclusion chromatography, affinity chromatography, GLC and HPLC, HPTLC.

##### Unit II

Centrifugation: Principles, differential and analytical centrifugation, density gradient centrifugation; Analysis of sub cellular fractions, ultracentrifuge and its application. Tracer technique: Nature of Radioactivity: Patterns of decay, half- life and its application, Use of isotopes in biological studies with special reference to recent literature.

##### Unit III

Electrophoresis: Principles, electrophoretic mobility, factors influencing electrophoretic mobility – paper, disc, slab gel electrophoresis. Isoelectric focusing, 2D PAGE, blotting techniques, capillary electrophoresis. Pulse field Electrophoresis.

##### Unit- IV

Spectroscopy: Laws of absorption and absorption spectrum.CD, ORD, Principle, instrumentation and applications of UV-visible spectrophotometry, ESR, NMR, IR and spectrofluorimetry. Recent Advancement in Instrumentation and analytical techniques for sports and exercise. Immunological techniques related to sports with recent advancements.

#### **Reference Books:**

- Principles and Techniques of Practical Biochemistry, Keith Wilson & John Walker, Cambridge University Press, India. 2005.
- Biophysical Chemistry (Principles and Techniques) 4th Edition, Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, Himalaya Publishing House, India, 2014.



- Bioanalytical Techniques, Abhilasha Shourie and Shilpa S Chapadgaonkar, the Energy and Resources Institute, TERI, India, 2015.
- Methods and Techniques, 2nd ed, C.R. Kothari, Research Methodology, New Age International Publishers. India, 2004.
- Introduction to Instrumental Analysis, Braun, R.P., Tata McGraw Hill, India, 1987.
- Textbook of Biochemistry, West, E.S. and Todd, W.R, MacMillan, Germany, 1985.
- Research Methodology, Methods and Techniques 2nd Edition, C.R. Kothari, New Age International Publishers. New Delhi, 2004.
- Fundamentals of Bio Analytical Techniques and Instrumentation, Ghosal Sabari and Srivastava A. K., PHI Learning Pvt. Ltd. India, 2009.
- Introduction to Spectroscopy. 3rd Edition. Pavia, Brooks/Cole Pub Co., New Delhi, India, 2000.
- Basic Instrumentation, K. K. Machve, Neha Publishers & Distributors, India 2010.

<b>MSSB 303</b>	<b>Discipline Elective IV</b>	<b>Credit 4</b>
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<b>MSSB 304</b>	<b>Discipline Elective V</b>	<b>Credit 4</b>
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<b>MSSB 305</b>	<b>Elective I</b>	<b>Credit 4</b>
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<b>MSSB 306</b>	<b>Practicum V</b>	<b>Credit 4</b>
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- Isolation of genomic DNA from blood.
- DNA amplification using Polymerase Chain Reaction.
- Estimation of DNA by spectrophotometric method
- Separation of DNA by Agarose Gel Electrophoresis
- Separation of protein by SDS-PAGE and staining
- Estimation Protein from various sources
- Isolation of RNA samples from blood, saliva, urine etc.
- Estimation of RNA

<b>MSSB 307</b>	<b>Practicum VI</b>	<b>Credit 4</b>
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- UV/Visible Spectral analysis of colouring pigments: Beta cyanin/ Anthocyanin/ Xanthine/ Lycopene and Curcumin
- Colorimetric assays
- Separation Techniques
- Chromatography (PC, TLC and Column)
- GC & HPLC, HPTLC (Demonstration only)
- Electrophoretic separation of protein
- Polyacrylamide gel electrophoresis
- Histopathology sample preparation
- Basis of immunostaining

<b>MSSB 308</b>	<b>Fitness</b>	<b>Credit 1</b>
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<b>MSSB 309</b>	<b>Societal</b>	<b>Credit 1</b>
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#### SEMESTER-IV

<b>MSSB 401</b>	<b>Discipline Elective VI</b>	<b>Credit 4</b>
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<b>MSSB 402</b>	<b>Elective II</b>	<b>Credit 4</b>
<b>MSSB 403</b>	<b>Dissertation</b>	<b>Credit 16</b>
<b>MSSB 404</b>	<b>Fitness</b>	<b>Credit 1</b>
<b>MSSB 405</b>	<b>Societal</b>	<b>Credit 1</b>

### Discipline Electives

<b>S.No.</b>	<b>Title of the Course</b>
1.	<p align="center"><b>Biochemical Aspects of Health in Sports</b></p> <p><u>Unit-I</u> Concept of Health and Disease, Lifestyle and Disease, Connection between Physical Activity and Health, Exercise and Its Benefits and hazards</p> <p><u>Unit-II</u> 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.</p> <p><u>Unit-III</u> Biochemical Basis of General Medical Issues For Athletes- Respiratory System, Cardiovascular System, Gastrointestinal system</p> <p><u>Unit-IV</u> Neurological, Muscular System, Overtraining Syndrome, Unusual Fatigue, Dry or Sticky Mouth, Eating Disorders, Sports Injuries, Sports Specific Health Issues.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>Functional Biochemistry in Health and Disease, Eric A. Newsholme and Tony R. Leech (2010) Willey-Blackwel, ISBN:978-0-471-931652.</li> <li>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.</li> <li>Medical Conditions in the athlete, Katie Walsh and Micki Cuppett (2017) Human Kinetics, ISBN:978-1-4925-3350.</li> <li>Health and Elite Sports, Joe Baker, Parisa Safai, Jessica Fraser-Thomas (2015) Routledge, ISBN:978-0-415-70866-1.</li> </ul>
2.	<p align="center"><b>Drugs and Doping in sports</b></p> <p><u>Unit I</u> 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,</p> <p><u>Unit II</u> 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.</p> <p><u>Unit III</u> 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.</p> <p><u>Unit –IV</u></p>

	<p>WADA and NADA Rules and Regulations Regarding Inadvertent Use of Prohibited Substances.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• Anthony C Hackey (2017) Doping, Performance-Enhancing Drugs, and Hormones in Sports ISBN:978-0-12-813442-9.</li> <li>• David R. Mottram, Neil Chester (2018) Drugs in Sports, Routledge, ISBN:1351838989.</li> <li>• Portefield, Jason (2008) Doping: athletes and drugs, Rosenn Publishing, New York, ISBN:1-4042-1917-5.</li> </ul>
3.	<p style="text-align: center;"><b>Endocrinology in Sports</b></p> <p><u>Unit-I</u> 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;</p> <p><u>Unit-II</u> 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;</p> <p><u>Unit-III</u> Exercise and the Hypothalamus; Exercise Training in the Normal Female; Adrenergic Regulation of Energy Metabolism; Hormonal Regulation of Fluid Homeostasis During and Following Exercise</p> <p><u>Unit-IV</u> 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</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• Warren, Michelle P., and Naama W. Constantini, eds. Sports endocrinology. Vol. 23. Springer Science &amp; Business Media, 2000.</li> <li>• Lanfranco, Fabio, and Christian J. Strasburger, eds. Sports Endocrinology. Karger Medical and Scientific Publishers, 2016.</li> <li>• Constantini, Naama, and Anthony C. Hackney, eds. Endocrinology of physical activity and sport. New York: Humana Press, 2013.</li> </ul>
4.	<p style="text-align: center;"><b>Essentials of Molecular Biology</b></p> <p><u>Unit-I</u> 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.</p> <p><u>Unit-II</u> Organisation of eukaryotic genome- components of eukaryotic chromatin and chromosome structure- DNA-supercoiling - linking number.</p> <p><u>Unit-III</u> 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</p> <p><u>Unit-IV</u> Transcription- eukaryotic Transcription- RNA polymerases general and specific transcription factors- regulatory elements- mechanism of transcription regulation- Transcription termination.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• 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</li> <li>• Lehninger's Principles of Biochemistry, sixth Edition, 2009 Publisher: W. H. Freeman; 6th edition   ISBN: 071677108X</li> <li>• Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Publishing Inc, 2000.</li> <li>• Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Molecular biology of the Cell. 4th ed. Garland publishing Inc, 2002</li> <li>• Benjamin Lewin. Gene VII. Oxford University Press, Nelson Cox.</li> </ul>
5.	<p style="text-align: center;"><b>Fatigue, Injuries and Rehabilitation</b></p> <p><u>Unit-I</u> 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</p>

	<p>Overtraining Syndrome.</p> <p><u>Unit II</u> 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</p> <p><u>Unit-III</u> 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</p> <p><u>Unit-IV</u> 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</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• Shaun Phillips (2015) Fatigue in Sport and Exercise. Routledge, NY</li> <li>• Therapeutic Modalities for Musculoskeletal Injuries 4th Edition, Human Kinetics by Craig Denegar, Ethan Saliba, Susan Saliba, 2016</li> <li>• Essentials of Athletic injury management 10th edition by William E. Prentice, Human Kinetics.</li> <li>• Clinical Sports Medicine Fifth Edition by Peter Brukner, Karim Khan, McGraw-Hill Education Australia, 2016</li> <li>• Principles and Practice of Therapeutic Massage by Sinha, Jaypee Publishers</li> <li>• Textbook of Electrotherapy by Singh Jagmohan, Jaypee Publishers</li> <li>• 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.</li> </ul>
6.	<p style="text-align: center;"><b>Genetics in Sports Performance</b></p> <p><u>Unit I</u> Basic Genetic Concepts, Mendelian inheritance, population genetics, Human chromosome Karyotype, Chromosome Disorders, Genome Structure and Genetic Mapping, Mitochondrial Inheritance,</p> <p><u>Unit II</u> The Genetic Code and Genetic Alterations, DNA Injuries and Repair, Monogenic and Polygenetic Diseases, Molecular Diagnostics, Epigenetics in sports.</p> <p><u>Unit III</u> 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</p> <p><u>Unit IV</u> 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</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• Bruce R. Korf and Mira B Irons (2012) Human Genetics and Genomics, WILEY-BLACKWELL</li> <li>• Manu L Kothari, Lopa A Mehta, Sadhana S roychoudhury, (2009) Principles of Genetics, Universities Press</li> <li>• Ricki Lewis (2017) Human Genetics the basics, Routledge, ISBN 978-1-138-66801-0</li> <li>• Michael Posthum and Malcolm Collins (2016) Genetics and Sports, Karger Publisher</li> <li>• Elaine A. Ostrander, Heather J. Huson, and Gary K. Ostrander Genetics of Athletic Performance (2009) Annu. Rev.</li> <li>• Genomics Hum. Genet. 2009.10:407–29</li> <li>• Lisa M. Guth and Stephen M. Roth (2013) Genetic influence on athletic performance, Curr Opin Pediatr. 2013 December; 25(6): 653–658.</li> <li>• Nicola Mafulli et al (2013) the genetics of sports injuries and athletic performance. Muscles, Ligaments and Tendons Journal, 3 (3): 173-189</li> </ul>
7.	<p style="text-align: center;"><b>Health Fitness and Wellness</b></p> <p><u>Unit-I</u> Introduction to Health: Concept of health, Lifestyle and Disease, Ageing.</p> <p><u>Unit-II</u> Physical Activities &amp; Fitness: Concept to Fitness, Exercise and its Principles, Health Education Recreation &amp; Dance.</p> <p><u>Unit-III</u> Healthy Life Style Approach: Concept of Wellness, Wellbeing, Stress Management.</p>

	<p><u>Unit-IV</u> Spiritual and mental fitness-its concept - anxiety management and motivation.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• "Fitness and Wellness" : Warner W. K Hoeger and Sharvon A. Hoeger</li> <li>• "Fitness &amp; Wellness concepts": Charles B. Corbina &amp; Ruth Lindsey</li> <li>• "Lifetime Fitness &amp; Wellness - A personal choice": Melvin H. Williams</li> <li>• Oxford Textbook of Public Health, Helen Liepman.</li> <li>• Sunderlal, Aadarsh, Pankaj, 2007, Textbook of Community Medicine, CBS Publishers &amp; Distributors.</li> <li>• Kirch, Wilhelm, 2008, Encyclopedia of Public Health, Volume 1 &amp; 2, Kluwer Academic Publishers.</li> <li>• Mary -Jane Schneider and Henrey Schneider, 2006 (2nd edition), Introduction to Public Health, Jones and Bartlett Publishers.</li> </ul>
8.	<p style="text-align: center;"><b>Immunology in Sports Training</b></p> <p><u>Unit-I</u> 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.</p> <p><u>Unit-II</u> Relevance of Immune Function to Athletes, Causes of Illness in Athletes, Intensive Training &amp; Effects on Immune Function, Allergy in Sports, Practical Guidelines on Minimising Infection Risk in Athletes.</p> <p><u>Unit-III</u> Strategies to Limit Exercise Induced Immune Depression, Strategies to Support Immunity for Athletes, Immunological Aspects of Sport Nutrition, and Clinical Implication of Exercise Immunology.</p> <p><u>Unit-IV</u> 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</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• Kuby Immunology- Judith A. Owen, Jenni Punt (2013) W. H. Freeman, ISBN: 1464137846.</li> <li>• Basic Immunology-Abul Abbas, Andrew H. Lichtman, Shiv Pillai (2015) Elsevier, ISBN: 9780323390828.</li> <li>• Immunology by Fathimunisa Begum (2014), PHI Learning Private Limited, ISBN-978-81-203-4983-4.</li> <li>• Exercise immunology- Editors, Michael Gleeson, Nicolette Bishop, Neil Walsh, (2013) Routledge Publisher, ISBN-13: 978-0415507264.</li> <li>• Immunological aspects of sport nutrition. Immunology and Cell Biology, GLEESON, M., 2016., 94 (2), pp. 117-123.</li> <li>• Immune function in sport and exercise Michael Gleeson J Appl Physiol 103: 693–699, 2007;doi:10.1152/jappphysiol.00008.2007.</li> <li>• Clinical implications of exercise immunology, David C Nieman (2012), Journal of Sport and Health Science 1 (2012)12e17.</li> </ul>
9.	<p style="text-align: center;"><b>Medical Biochemistry</b></p> <p><u>Unit –I</u> 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.</p> <p><u>Unit-II</u> 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.</p> <p><u>Unit-III</u> 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.</p> <p><u>Unit-IV</u> Clinical Enzymology - Laboratory investigations on serum and urine for constituents (normal &amp; 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.</p>

	<p><b>References books</b></p> <ul style="list-style-type: none"> <li>• Harper's Review of Biochemistry - Ed By David Martin et al Lange Medical Publications 1987/Latest.</li> <li>• Metabolic control and disease – Ed. Roxenburg and Philip K. Bondy W.B. Saunders -Latest.</li> <li>• Biochemistry - A case oriented approach by Montogommoiry - CV Moshy Vo. / Latest.</li> <li>• Biochemistry - A functional approach by Mc Gilvery - W.B. Saunders Co., Latest.</li> <li>• Principles of Biochemist Vol. I and II by White Handler Smith al - Latest Edition McGraw Hill Publication.</li> <li>• Text book of Clinical Chemistry by Norbert Tietc – 1986 W.B. Saunders Co., Latest.</li> <li>• Metabolic Basis of inherited diseases by Stanbury, Wyngarden et al, W.B. Saunders Co., Latest.</li> </ul>
10	<p style="text-align: center;"><b>Nutritional Biochemistry</b></p> <p><u>Unit-I</u> 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.</p> <p><u>Unit-II</u> 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,</p> <p><u>Unit-III</u> Food Sources of Nutrients, Nutrient Digestion and Absorption, Nutrient Toxicities, Free Radicals and Anti-oxidants.</p> <p><u>Unit-IV</u> 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.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• The Biochemical Basis of Sports Performance- Ronald J Maughan and Michael Gleeson (2010) Oxford University Press, ISBN:9780199208289.</li> <li>• Biochemistry for Sports and Exercise Metabolism- Don MacLaren, James Morton, (2011) Wiley-Blackwell Publisher, ISBN-978-0-470-09185-2.</li> <li>• Fundamentals of Human Nutrition- Catherine Heissler, Hilary Powers (2015) Churchill Livingstone Elsevier, ISBN:9780443069727.</li> <li>• Nutrition Chemistry and Biology- by Julian F. Spallholz and Mallory Boylan (1998), CRC Press, ISBN 13: 978-0849385049.</li> <li>• Brooks, GA; Fahey, TD; Baldwin KM/Exercise physiology: human bioenergetics and its applications/Fourth Edition/2005.</li> </ul>
11	<p style="text-align: center;"><b>Performance Evaluation and Testing</b></p> <p><u>Unit-I</u> 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:</p> <p><u>Unit-II</u> 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,</p> <p><u>Unit-III</u> 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)</p> <p><u>Unit-IV</u> 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</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>• Advanced Fitness Assessment and Exercise Prescription 8th Edition with Online Video, Human Kinetics by Ann Gibson, Dale Wagner, Vivian Heyward, 2018.</li> <li>• Laboratory Manual for Exercise Physiology 2nd Edition. With Web Study Guide, Human Kinetics by G. Gregory Haff, Charles Dumke, 2018.</li> <li>• Measurement and Evaluation in Human Performance 5th Edition, Human Kinetics by James Morrow Jr., Dale Mood, James Disch, Minsoo Kang, 2016.</li> <li>• Physiological Tests for Elite Athletes 2nd Edition by Australian Institute of Sport Rebecca Tanner, Christopher Gore, 2012.</li> <li>• ACSM's Guidelines for Exercise Testing and Prescription, 10th Edition by American College of Sports Medicine.</li> </ul>

	<p>Wolters Kluwer, 2017.</p> <ul style="list-style-type: none"> <li>Text book of Applied Measurement Evaluation &amp; Sports Selection second edition: Dewinder K Kansal Sports &amp; Spiritual Science Publications.</li> <li>Heyward, Vivian. Advanced Fitness Assessment and Exercise Prescription, 5th ed., Human Kinetics, 2006.</li> <li>ACSM's Guidelines for Exercise Testing and Prescription, 8th ed., Lippincott Williams and Wilkins, 2009.</li> <li>ACSM's Health-Related Physical Fitness Assessment Manual, 3rd ed., 2009.</li> </ul>
12	<p style="text-align: center;"><b>Research Methodology</b></p> <p><u>Unit-I</u> 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</p> <p><u>Unit-II</u> 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</p> <p><u>Unit-III</u> 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</p> <p><u>Unit-IV</u> 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.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>Research Methodology: Methods and Techniques by C. R. Kothari.</li> <li>ICMR. Ethical Guidelines for Biomedical Research on Human Subjects. 2006; ICMR, New Delhi.</li> <li>Research Methods in Physical Activity- 7th Edition By Jerry Thomas, Jack Nelson, Stephen Silverman, Human Kinetics</li> <li>Research Methods in Sport by Mark F Smith.</li> <li>Research Methods for Sports Performance Analysis By Peter O' Donoghue.</li> <li>Research Methods in Physical Education and Youth Sport 1st Edition by Kathleen Armour and Doune Macdonald.</li> <li>Ridley, D. The Literature Review a step-by-step guide for students. 2012; Sage Publications Limited, New Delhi.</li> </ul>
13	<p style="text-align: center;"><b>Statistics for Sports Science</b></p> <p><u>Unit-I</u> 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.</p> <p><u>Unit-II</u> 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.</p> <p><u>Unit-III</u> 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.</p> <p><u>Unit-IV</u> Introduction and Application of Statistical Software. Computer applications- statistical packages for data analyses- SPSS, e-mail, search engines and Microsoft office.</p> <p><b>Recommended Books:</b></p> <ul style="list-style-type: none"> <li>A Text book of Biostatistics, by A.K.Sharma, Discovery publishing house</li> <li>Introduction to Biostatistics, By Dr. Pranab Kumar Banerjee, S. Chand Publishers</li> <li>Research Methodology: Methods and Techniques Book by C. R. Kothari Dutta N.K.</li> <li>Fundamentals of Bio-Statistics. 2002; Kanishka Publishers, New Delhi. Gupta S.P.</li> <li>Statistical Methods. 2004; S. Chand &amp; Sons, New Delhi. Ruud H. Koning and James H. Albert ( 2008) S</li> <li>Statistical thinking in sports. Chapman &amp; Hall/CRC.</li> </ul>