

**Department of Sports Biosciences
School of Sports Sciences**



Proposed Syllabus for Ph.D. in Sports Biosciences

Central University of Rajasthan
NH-8, Bandar Sindri
Kishangarh- 305817
Ajmer, Rajasthan

**Department of Sports Biosciences
School of Sports Sciences
Central University of Rajasthan
Course structure of PhD syllabus**

Course Name: PhD Sports Biosciences.

A. Program Eligibility:

A consistently good academic record possessing a Master's Degree in the subject concerned including M.Sc. Sports biochemistry, M.Sc. Sports nutrition, M.Sc. Sports physiology or any other relevant allied subjects with minimum of 55% marks or equivalent grade from a recognized University at both undergraduate and postgraduate levels; 5% relaxation in minimum requirement of marks is granted to SC/ST/OBC/PWD candidates.

B. Program Objectives:

- This program aims to encourage the new talent in sports bioscience, where students can acquire the knowledge in advanced research problems.
- This program helps the students to understand in depth underlying scientific questions in sports biosciences, and uncovering the unknown mechanisms, theories in both basic and advanced sports bioscience.
- Creating skilled professional with expertise in current trends of research in the area of sports bioscience.
- Will allow the students to have hands-on experience on different techniques and instrumentation of advanced sports biological sciences.
- Inculcating the scientific ethics, temperament to contribute to field of science and help in nation building.
- Generating independent researchers who are capable of translating the research developed at laboratory scale to the field.
- Generates a successful academician, scientists or entrepreneur.

C. Program outcomes:

- The Students successfully completing the course will have following skills.
- Solid basic knowledge of research methodologies in area of modern Sports bioscience.
- Contributing new methodologies and results in area of the Sports bioscience for taking the research to next level.
- Innovative scientists, skilled workforce to work in specialized area of Sports bioscience.
- Independent researchers who can contribute through fulfilling responsibility of academicians, scientist and entrepreneur in the field of sports biosciences.
- Can start an independent research and can contribute in solving new problems faced in current science or in future.

D. Employability:

- As academicians in different university or colleges at national and international levels as a researcher at different research institute at national and international level where they can initiate their independent research.
- As a sports scientist in leading national bodies and private industries.
- As a consultant to Training elite athletes in professional sports, Fitness testing personal.

Course Structure

Semester I

| Code | Title of the course | Type of Course | Credits |
|--|--|----------------|---------|
| SBS701 | Research Methodology | Core | 2 |
| SBS 702 | Research and Publication Ethics | Core | 2 |
| EDU705 | Pedagogy for Higher Education | Core | 3 |
| Elective I- Advanced specialized area (any two from 703 to 712) | | | |
| SBS 731 | Molecular Basis of Sports Biochemistry | Core | 4+4 |
| SBS 732 | Basics of Exercise Science | Core | |
| SBS 733 | Advanced research tools in sports biochemistry | Core | |
| SBS 734 | Sports Cardiology | Core | |
| SBS 735 | Supplements in Sports Nutrition | Core | |
| SBS 736 | Doping in Sports | Core | |
| SBS 737 | Physiological and Biochemical Adaptations | Core | |
| SBS 738 | Biosensors for sports analytics and performance augmentation | Core | |
| SBS 739 | Implications of exercise physiology | Core | |
| SBS 740 | Nutraceuticals and Foodomics in Health and Fitness | Core | |

Total Credits: 15

The PhD student will be assigned to a supervisor based on his/her research interest and availability of supervisor. After the successful completion of course work. Under the guidance of assigned supervisor the PhD student will develop a proposal and perform the dissertation work (As per Ordinance 9, PhD CURAJ).

Semester I

Course Objectives

- To understand the basic of research methodologies adapted for designing a project till completion and sharing of the observed results through publications.
- To learn basics of statistics for qualitative and quantitative analysis and deduce inferences from the observed biological data.
- To understand the structure of proposals, thesis and research publication.
- To learn basic tools in microbiological sciences which will be utilized during the course of PhD

Learning Outcomes

- Solid basic knowledge of research methodologies in area of modern biological sciences
- Innovative scientists, skilled workforce to work in specialized area of microbiology
- Independent researchers who can contribute through fulfilling responsibility of academicians, scientist and entrepreneur
- Can start an independent research and can contribute in solving new problems faced in current science or in future.

| SBS 701 | Research Methodology | 2 credits |
|---|-----------------------------|------------------|
| Unit-I: Definition, purpose and types of research methodology. Process of research, objectives of the research. Design, methods and tools of research. Characteristics of good research study. Research writing - Types of scientific documents-research paper, review paper, book reviews, thesis, conference and project reports. Thesis writing structuring the Ph.D. Thesis: chapter format, pagination, identification, using quotations, footnotes, abbreviations, presentation of tables and figures, referencing, documentation, use and format of appendices, indexing. Scientific proposal writing: An Insight into Research proposal: Definition and basic concepts, defining the problem, creating a hypothesis, objectives, work plan, significance and techniques of research, expected outcome, finding research materials – literature survey, compiling records. Research paper - Components of a research paper – title, authors and addresses, abstract, acknowledgements, references, tables and illustrations. c) Dealing with publishers – submission of manuscript, ordering reprints. d) Oral and poster presentation of research papers in conferences/symposia. e) Preparation and submission of research project proposals to funding agencies. | | |
| Unit-II: Biostatistics: Data Collection, presentation, data processing, classification and tabulation. Measures of Central tendency and Dispersion. Probability distribution: Binomial, Poisson and Normal. Confidence Interval, Errors. Sampling: types, steps; sampling errors Quantitative Techniques: Levels of significance, Regression and Correlation, Interpolation and Extrapolation, Sampling of attributes (including chi square test), Sampling of small and large sample variables (including Anova) Hypothesis Testing: fundamentals of hypothesis testing . Statistical decision theory Parametric vs. non-parametric tests, univariate analysis, Multivariate analysis. On hand training of SPSS in statistical analysis. | | |
| Recommended books: <ul style="list-style-type: none"> • Research Methodology. Methods and Techniques: Kothari, C. R. • Tests, Measurements and Research Methods in Behavioural Sciences : Singh, A. K • Biostatistics: A foundation for Analysis in the Health Sciences 7/E Wayne W. Daniel, Wiley Series in Probability and Statistics. • Introductory Statistics. Fifth Edition. (2004) Prem S. Mann. John Wiley and Sons (ASIA) Pvt. Ltd. • Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery (S. C. Rastogi, N. Mendiratta, and P. Rastogi). • Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J). • Marder M P (2011) Research Methods for Science, Cambridge University Press • Rosner B (2010) Fundamentals of Biostatistics, 7th Edition, Brooks/Cole Cengage Learning Publication • Dunleavy P (2003) Authoring a PhD: How to Plan, Draft, Write and Finish a Doctoral Thesis or Dissertation. Palgrave Macmillan | | |

| SBS 702 | Research and Publication Ethics | 2 credits |
|---|--|------------------|
| Unit -1 Philosophy and ethics : Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgment and reactions. Scientific Conduct: Ethics with respect to science and research; Intellectual honesty and research integrity; Scientific misconducts: falsification, Fabrication, and plagiarism (FFP); Redundant publications: duplicate and overlapping publications, salami slicing; Selective reporting and misrepresentation of data. Publications ethics: Publication ethics: definition, introduction and importance; best practices/standards setting initiatives and guidelines: COPE, WAME, etc.; conflict of interest; Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types.; Violation of publication ethics, authorship and contributionship.; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals. | | |

Unit -2

Open access publishing: Open access publications and initiatives, SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; software tool to identify predatory publications developed by SPPU; Journal finder/Journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.,

Publication misconduct:

- (A) Group discussions: Subject specific ethical issues, FFP, authorship; conflict of interest; Complaints and appeals: examples and fraud from India and abroad. (B) Software tools: Use of plagiarism software like turnitin, urkund and other open source software tools.

Databases and research metrics: (A) Databases: indexing databases, Citation databases: web of science, Scopus etc.; Research metrics: impact factor of journal as per journal citation report, SNIP, SJR, IPP, Citescore.; Metrics: h-index, g index, i10 index. Altmetrics.

Recommended books:

- Bird, A.(2006). Philosophy of Science. Routledge.
- Macintyre, A.Jasdair (1967) A Short History of Ethics. London.
- P.Cbaddah,(2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN :978-9387480865
- National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.
- Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
- Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
- Indfan National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN :978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf

Elective 731 to 740**Specialized papers**

Any two out of 731to 740 (Each paper with 4 credits)

Course Objectives

- The course is designed to learn the advances in different specialized subjects of Sports Bioscience
- To understand the specialized knowledge of the elected subject from research area such as Molecular Basis of Sports Biochemistry, Basics of Exercise Science, Advanced tools and techniques in sports biochemistry, Sports Cardiology, Supplements in Sports Nutrition, Environmental Exercise Physiology and Physiological and Biochemical Adaptations.

Learning Outcomes

- Capable of understanding different fundamentals concepts and specialized knowledge of different Sports Bioscience areas.
- Can apply the knowledge gained in developing the project proposal during PhD dissertation work.
- Independent researchers who can contribute through fulfilling responsibility of academicians, scientist and entrepreneur
- Can start an independent research and can contribute in solving new problems faced in current science or in future.

Course Structures

| SBS 731 | Molecular Basis of Sports Biochemistry | 4 credits |
|---|--|-----------|
| Unit-I: Introduction to clinical biochemistry: Water and electrolyte balance; Regulation of water and electrolyte balance, role of kidney and hormones; Acid base balance regulation by human body; concept of metabolic and respiratory; acidosis and alkalosis. | | |
| Unit-II: Hematology: Composition of blood, Mechanism and regulation of blood coagulation, fibrinolysis, Neuro-muscular system: Mechanism of conduction of nerve impulse along axon, neurotransmitters, Biochemistry of vision Ultra structure and molecular mechanism of contraction of skeleton and smooth muscles and its regulation. Enzymes: Principles of diagnostic enzymology: Evaluation of organ function tests; Clinical presentation and diagnosis of renal, hepatic and pancreatic diseases; Cardiac function tests and Thyroid function tests; Diagnostic significance and interpretation of glucose tolerance test; Diagnostic tests for Apo lipoproteins, HDL cholesterol, LDL cholesterol and triglyceride disorders; Use of enzymes in the diagnosis and monitoring of myocardial infarction, liver diseases and pancreatic diseases. Normal and abnormal serum values of the enzymes and their significance, acid and alkaline phosphatase, SGOT, SGPT, α -amylase, LDH, creatine kinase, troponin T | | |
| Unit-III Replication: Unit of replication, Replication Origin and Replication Fork Enzymes involved in replication, Initiation, Elongation and Termination of Replication Fidelity of Replication, Transcription: Transcription in prokaryotes and eukaryotes, Transcriptional factors and their role, RNA polymerases, Formation of initiation complex, Elongation and termination, Inhibitors of transcription, RNA processing, splicing, polyadenylation, capping, Structure and function of different types of RNA's | | |
| Unit-IV Translation: Protein synthesis and genetic code, General characteristics of genetic code, Deciphering of genetic code, Ribosomes as the site of protein synthesis, polysomic, Activation of amino acids, Chain initiation, elongation and termination in prokaryotes and eukaryotes, Control of translation (Role of Guanine nucleotides), Translational fidelity, Kinetic proof reading, Positive and negative regulation of translation, Inhibitors of protein synthesis. Enzymes: DNA polymerase, restriction endonucleases, topoisomerase I and DNA Ligase, reverse transcriptase, kinase, alkaline phosphatase, nuclease, RNase H. Gene cloning: General strategy for gene cloning, transformation. | | |
| Recommended books: <ul style="list-style-type: none"> • Molecular Biology of the Cell, 4th Edition, by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, New York: Garland Science; 2002. • Biochemistry, 5th Ed. by J.M. Berg, J.L. Tymoczko and L. Stryer, W.H. Freeman and Company, 2002 • Lehninger Principles of Biochemistry, 5th Edition, by David L. Nelson, Michael M. Cox, W. H. Freeman 2008 | | |

| SBS 732 | Basics of Exercise Science | 4 credits |
|---|----------------------------|-----------|
| Unit-I: Bioenergetics of Exercise: Introduction to exercise science, ATP & muscular work, Metabolism of carbohydrate, fat and protein during exercise | | |
| Unit-II: Physiological systems during exercise: Skeletal muscle structure & function, Respiratory System Responses to Exercise, Cardiovascular System Responses to Exercise, Endocrine System Responses to Exercise, Immune System Responses to Exercise | | |
| Unit-III Exercise for Fitness & Performance: Adaptations to endurance training, adaptations to strength training, nutritional considerations for exercise, causes of muscle fatigue, performance enhancing drugs | | |
| Unit-IV Exercise in Health, Wellness and Disease: Exercise is medicine, Diet, exercise and weight control, Exercise and risk factors for heart disease, Exercise and risk factors for diabetes, Exercise and successful aging, Exercise and brain | | |

Recommended books:

- 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
- 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.
- Fitness and Wellness: Warner W. K Hoeger and Sharvon A. Hoeger
- Fitness & Wellness concepts: Charles B. Corbina & Ruth Lindsey
- Lifetime Fitness & Wellness - A personal choice": Melvin H. Williams
- Oxford Textbook of Public Health, Helen Liepman.

| SBS 733 | Advanced research tools in sports biochemistry | 4 credits |
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| Unit-I Biological databases to explore the regulators of exercise induced metabolic adaptations in athletes: Genomes, DNA sequences. Sequence databases: GeneBank, European Molecular Biology Laboratory (EMBL) Nucleotide sequence databank, DNA Data Bank of Japan (DDBJ), Protein databases; primary databases and secondary databases, database formats. Structural databases; Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular modeling Data Bank (MMDB). | | |
| Unit-II: Analytical techniques: Chemical and enzymatic methods of carbohydrate analysis, separation and identification of carbohydrates, lipids and amino acids mixtures; principle and methods of protein separation techniques, basic of chromatography-gel filtration, Ion exchange, affinity, HPLC, FPLC. Electrophoresis- SDS, AGE, IEF, protein-protein interaction, immune-precipitation, DNA-protein interaction, EMSA, ChIP assay and yeast two hybrid systems. Basic of Spectroscopy- UV-Vis, Fluorescence, CD, FTIR, NMR, X-ray crystallography, SPR. Basic of Microscopy- light, fluorescence, confocal, electron microscopy, phase-contrast, super-resolution | | |
| Unit-III: Recombinant DNA technology: Isolation and purification of nucleic acids; amplification of DNA using PCR, recombinant PCR, Asymmetric PCR, nested PCR, use of restriction and modification in enzymes in cloning, plasmid vectors, random and site directed mutagenesis, DNA sequencing, next generation sequencing. Identification of proteins by Western blotting, purification, If proteins by chromatography techniques, analysis of protein-protein interaction by biochemical techniques, Determination of binding parameters of protein-ligand interaction principle and applications of western blotting, Recombinant protein expression and purification in different host systems. | | |
| Unit-IV: Immunology: Purification and analysis of Immunoglobulins, Immunoprecipitation, Enzyme-linked immunosorbent assay (ELISA), Fluorescence-activated cell sorting (FACS) and analysis of cells, Immunostaining and imaging, Mammalian Cell Counting, Cell Biology: Separation of cellular organelles by density gradient; immunofluorescence imaging of cellular organelles, Analyses of cell cycle, actin and microtubule polymerization | | |
| Recommended books: <ul style="list-style-type: none"> • Voet D., Voet J.G, Biochemistry 4 th Edition., John Wiley and Sons, 2011. • Nelson, D. C. andCox, M.M., Lehninger Principles of Biochemistry, 5thEdition,W. H. Freeman, 2010. • Berg J.M., Tymoczko J.L. and Stryer L., Biochemistry. 7th edition, W.H. Freeman and Co, New York, 2011. • Molecular biology by Robert F. Weaver McGraw-Hill 4 edition (2007) • Advanced molecular biology by R. M. Twyman, (1998) • Genes VII by B. Lewin Oxford University Press, Cell Press, London (2000) | | |

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| SBS 734 | Sports Cardiology | 4 credits |
| Unit-I: Cardiovascular anatomy and physiology, Basic principles of exercise physiology, Impact of different sports and training regimes on cardiovascular system, structural and functional adaptation of cardiovascular system to exercise, Overtraining, cardiovascular fitness and its assessment | | |
| Unit-II: Principles of cardiovascular evaluation of athletes, Differentiation between physiological adaptation to exercise and phenotypes of cardiac disease, Health benefits of exercise in different populations (sedentary individuals, athletes, individuals with cardiovascular risk factors, individuals with established cardiac or respiratory disease) | | |
| Unit-III: Pre-participation and follow-up screening of athletes: ECG, ECG monitor, signal-averaged ECG, exercise ECG and cardiopulmonary exercise testing, echocardiography, cardiac MRI, CT coronary angiography and drug provocation testing. Case studies of different cardiac conditions in athletes. | | |
| Unit-IV: Principles of cardiovascular screening, Sudden cardiac death in young athletes, pre-participation cardiovascular screening, Advantages and limitations of different screening modalities, Cardiac Rehabilitation of Athletes and Patients with Cardiac Disorders | | |
| Recommended books: <ul style="list-style-type: none"> • Textbook of Sports and Exercise Cardiology by Pressler, Axel, Niebauer, Josef • The ESC Textbook of sports cardiology by Antonio Pelliccia, Hein Heidbuchel, Domenico Corrado, Mats Borjesson, and Sanjay Sharma • Human Anatomy and Physiology (10th 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 (10th 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 | | |

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|--|--|------------------|
| SBS 735 | Supplements in Sports Nutrition | 4 credits |
| Unit-I: Dietary supplements in sports nutrition and their classification, Doping, Anti-doping regulations, Banned substances, Use of steroids and their harmful effects, World anti-doping agency (WADA) and National Anti-doping agency (NADA), List of prohibited substances and Drugs | | |
| Unit-II: Macronutrient supplements: Protein supplements (Whey, Casein, Soy protein, Egg albumen, Pea protein, vegan proteins, protein bars and protein shakes), BCAAs, amino acid supplements, carbohydrates, Micronutrient supplements: vitamins (B-complex vitamins, Folic acid, vitamin B-12, vitamin D, multi-vitamin supplements), mineral supplements: calcium, magnesium, iron, potassium, sodium and zinc, antioxidants | | |
| Unit-III: Herbal supplements: Ginseng, Ashwagandha, Rhodiola, Tribulus terrestris, Shilajit, ginger, capsaicin, Ginkgo biloba, Functional phytochemicals: curcumin, caffeine. Green tea extract, flavonoids, beta-alanine, L-carnitine, tart cherries | | |
| Unit-IV: Importance of hydration for athletes, Dehydration and performance, Fluid losses and assessing hydration status, Fluids and electrolytes balance in sports, Electrolyte replacement drinks, Sports drinks | | |

Recommended books:

- Greenwood, M., Cooke, M.B., Ziegenfuss, T., Kalman, D.S., Antonio, J.(2015). Nutritional Supplements in Sports and Exercise
- Dan Benardot (2020) Advanced sports nutrition
- Antonio, J., & Stout, J. R. (2002). Supplements for endurance athletes. Human Kinetics.
- Greenwood, M., Cooke, M. B., Ziegenfuss, T., Kalman, D. S., & Antonio, J. (Eds.). (2015). Nutritional supplements in sports and exercise. Humana Press.
- Cooper, C. E. (2008). Drugs and ergogenic aids to improve sport performance. Essays in biochemistry, 44, 1-10.

| SBS 736 | Doping in sports | 4 credits |
|--|-------------------------|------------------|
| 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: (1) Anthony C Hackey (2017) Doping, Performance-Enhancing Drugs, and Hormones in Sports ISBN:978-0-12-813442-9. (2) David R. Mottram, Neil Chester (2018) Drugs in Sports, Routledge, ISBN:1351838989. (3) Portefield, Jason (2008) Doping: athletes and drugs, Rosenn Publishing, New York, ISBN:1-4042-1917-5. | | |

| SBS 737 | Physiological and Biochemical adaptations | 4 credits |
|---|--|------------------|
| Unit-I: Physiological responses to exercise/sports: Cardiovascular and respiratory system, Skeletal muscle energy metabolism, hormonal responses to exercise, immune responses to exercise, physiological adaptations to interval training | | |
| Unit-II: Long-term adaptations to exercise training: Adaptations of skeletal muscle and bone, metabolic adaptations, long-term cardiovascular adaptations, Respiratory adaptations, Maintenance, detraining and prolonged inactivity | | |
| Unit-III: Biochemical adaptations to endurance exercise: aerobic metabolism, anaerobic metabolism, Energetics of muscular exercise, skeletal muscle biochemical adaptations, neuromuscular adaptations to exercise, mitochondrial response and adaptation to training | | |
| Unit-IV: Adaptation to High altitude training and competitions, Altitude acclimatization, training and performance, physiological implications of altitude training for endurance performance, Acclimatization for training in hot environmental conditions: physiological and performance effects | | |
| 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
- Brooks, Fahey, White, and Baldwin, Exercise Physiology. Mayfield. Third Edition

| SBS 738 | Biosensors for sports analytics and performance augmentation | 4 credits |
|---|--|-----------|
| Unit-I: Sensors: fundamentals, types and detection principles, calibration, selectivity, sensitivity, reproducibility, detection limits, response time; electrochemical sensors: amperometric, potentiometric, conductimetric; Chronoamperometry and Chronopotentiometry; Optical sensors: absorption, fluorescence, SPR; piezoelectric sensors; Thermal transducers; electronic sensors; modelling; economics; biosensors; techniques employed in fabrication of biosensors and detection of analytes; measurement principles; nanobiosensors; ambient sensors | | |
| Unit-II: Biomolecules as biosensors: enzymatic, immunosensors, aptamers, peptides and whole-cell; Kinetics of biomolecular sensors; Biorecognition Systems: Enzymes; oligonucleotides and nucleic acids; lipids; membrane receptors and transporters; tissue and organelles (animal and plant tissue); cell culture, limitations and problems, immobilization of biomolecules; Design and Fabrication of Biosensors: Self-assembled mono layers screen printing, photolithography, micro-contact printing, MEMS, miniaturization-application of nano-materials, nanoparticles, carbon nanotubes (CNTs) and others; Bioelectric Tattoos; Wireless biosensor networks; biosensors in health and wellness monitoring | | |
| Unit-III: Biosensors for sports and athletes; Biosensors based detection in sports: fundamentals and kinetics; biodetection principles; biosensors for monitoring the respiration, hydration, stress and water:electrolyte ration in athletes; glucose sensors; lactate sensors; continuous glucose and lactate monitoring sensors; conductivity sensors; cortisol sensors; biosensors for monitoring the hormonal state of the athlete: sterone biosensors; actigraphy motion biosensors | | |
| Unit-IV: Wearable sensors for sports: Accelerometer, gyroscope, magnetometer, heart rate sensors, pedometers; commercial sensors available for sports: types, fabrication principles, market, importance; smart clothing: e-textile system for remote, continuous monitoring of physiological and movement data; monitoring the mental acuity of athletes; monitoring the biochemical status of the athlete by detecting biomarkers from sweat and saliva; case studies | | |
| Recommended books: <ol style="list-style-type: none"> 1. Sadana, N., Sadana, A. (2016). Handbook of Biosensors and Biosensor Kinetics. Netherlands: Elsevier Science. 2. Evtugyn, G. (2013). Biosensors: Essentials. Germany: Springer Berlin Heidelberg. 3. Herold, K. E. (2009). Biosensors and biodetection. A. Rasooly, & K. E. Herold (Eds.). Totowa, NJ: Humana Press. 4. Electrochemical, Bioelectronic, Piezoelectric, Cellular and Molecular Biosensors. (2018). United States: Springer New York. 5. Malhotra, B. D., & Turner, A. (2003). Advances in Biosensors: Perspectives in Biosensors: Elsevier Science. 6. Sadana, A., Sadana, N. (2014). Biomarkers and Biosensors: Detection and Binding to Biosensor Surfaces and Biomarkers Applications. Netherlands: Elsevier Science. 6. Lai-Kwan, C., & Chang, H. T. (2012). From Bioimaging to Biosensors: Noble Metal Nanoparticles in Biodetection: Jenny Stanford Publishing. Tiwari, A., & Turner, A. P. F. (2014). Biosensors Nanotechnology: Wiley. | | |

| SBS 739 | Implications of Exercise physiology | 4 credits |
|--|-------------------------------------|-----------|
| Unit-I: Physical activity monitoring and guidance - Relative versus absolute intensity of physical activity - Aerobic exercise - Muscular strength and endurance - Establishing the strength training prescription – Flexibility balance / coordination / proprioception and movement control. | | |
| Unit-II: Metabolic syndrome: Obesity and diabetes - Etiology of obesity and diabetes; Prevalence of obesity and diabetes; Evidence that physical activity reduces the risk of obesity and diabetes; Role of physical activity in managing obesity and diabetes; Exercise prescription for the prevention and management of obesity and diabetes; Co-morbidities; Gaps in the evidence and exercise issues in people with Obesity - Diabetes | | |
| Unit-III: 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 – Arteriovenous O2 Difference - Detraining and V02 Max - Endurance Training: Effects on Performance and Homeostasis - Physiology Adaptations and the Oxygen Deficit | | |
| Unit-IV: Physiology Adaptations and the Plasma Glucose Concentration - Physiology Adaptations and Blood pH - Physiology. Adaptations and Lactate Removal - Endurance Training: Links Between Muscle and Systemic Physiology - Peripheral Feedback - Central Command - Physiological Effects of Strength Training - Physiological Mechanisms Causing Increased Strength - Muscular Enlargement - Concurrent Strength and Endurance Training | | |
| Recommended books: 1. Physiology of Sport and Exercise 6th Edition with Web Study Guide-Loose-Leaf Edition by W. Larry Kenney, Jack Wilmore, David Costill. 2. Physiological Aspects of Sport Training and Performance With Web Resource- 2nd Edition, Human Kinetics By Jay Hoffman 3. Exercise Physiology: Theory and Application to Fitness and Performance 10th Edition By Scott Powers and Edward Howley 2018. 4. Exercise Physiology: Nutrition, Energy, and Human Performance 8th Edition by William D. McArdle, Frank I. Katch, Victor L. Katch; 5. Textbook of Sports and Exercise Cardiology by Pressler, Axel, Niebauer, Josef 6. The ESC Textbook of sports cardiology by Antonio Pelliccia, Hein Heidbuchel, Domenico Corrado, Mats Borjesson, and Sanjay Sharma | | |

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| SBS 740 | Nutraceuticals and Foodomics in health and fitness | 4 credits |
| Unit-I: Functional Foods -Definition, Relation of functional foods & Nutraceutical (FFN) to foods & drugs. Applications of herbs to functional foods. Concept of free radicals and antioxidants; Nutritive and Non-nutritive food components with potential health effects. Effect of processing on Nutrients. Soy proteins and soy isoflavones in human health; Role of nuts in cardiovascular disease prevention. Functional foods from wheat and rice and their health effects. | | |
| Unit-II: Phytonutrients-: Phytonutrients & Sources and role of Isoprenoids, Isoflavones, Flavonoids, carotenoids, Tocotrienols, Polyunsaturated fatty acids, sphingolipids, lecithin, choline. terpenoids. Vegetables, Cereals, milk and dairy products as Functional foods. Health effects of common beans, Capsicum annum, mustards, Ginseng, garlic, grape, citrus fruits, fish oils, and sea foods, traditional spices. | | |
| Unit-III: Food Genomics - I: Foodomics impact on optimal impact: Introduction, Nutrigenomics, Nutrigenetics, Personalized nutrition, The added value of foodomics for the food industry | | |
| Unit-IV: Nutritional Genomics – II: Plants as ‘bioreactors’ as a tool for production of Nutraceuticals. ‘Tailor-made’ carbohydrates and lipids of plant and non-plant origin. Plants as an alternative for biotransformation of raw materials into special chemicals. | | |
| Recommended books: 1. Handbook of Nutraceuticals and Functional Foods (Modern Nutrition) Hardcover – 9 December 2019 by Robert E.C. Wildman (Editor), Richard S. Bruno (Editor) 2- Nutraceuticals and Functional Foods in Human Health and Disease Prevention Hardcover – Import, 15 October 2015 by Debasis Bagchi (Editor), Harry G. Preuss (Editor), Anand Swaroop (Editor) 3- Genomics, Proteomics and Metabolomics in Nutraceuticals by <u>Manashi Bagchi</u> , <u>Debasis Bagchi</u> , <u>Francis C. Lau</u> | | |

Course code: EDU 705

Pedagogy for Higher Education *(prepared by Dr Anjali Sharma)*

Credits:03 (About 45 hours of interactive learning events that will include lectures, discussions with practice sessions and additional off the class self-learning activities)

Aim and Outline of the course:

The course is designed for the research scholars (may call the prospective teacher of higher education or PhD Entrants) to join higher education institutes as professionals. A researcher generally engages in the teaching-learning process after completing their research and sometimes participates in teaching-learning during their research period as a teacher assistant. Therefore, it is required to give them exposure to the teaching-learning process for conceptual understanding and skill development.

This course will help them understand the teaching-learning process basics, curriculum and assessment, and classroom management. This course will also help scholars be more effective while presenting in seminars and conferences.

Besides developing conceptual knowledge of pedagogy skills this course covers contemporary higher education issues like choice-based credit system, online learning, open-book examination, web-based and research-based pedagogical tools and MOOCs etc.

The scholars would develop insight into the significance of pedagogical knowledge and its implication in their professional life on completing the course. Thus the scholars who complete this course will be fully equipped to teach well immediately as they join any educational institute.

Learning Outcomes

On successful completion of this course the participants will be able to:

- Describe teaching-learning processes especially in context of higher education
- Develop an instructional plan as per the teaching strategy needed.
- Design learning events using different teaching methods
- Use activities and exercises as per the required teaching approach
- Develop web based and research-based pedagogical tool
- Explore the ways to handle diverse group of learners in the classroom
- Use technology effectively to facilitate and support e-learning
- Prepare assessment rubric for achievement testing of students and portfolio
- Demonstrate enhanced competency in communication with students
- Use visual aids and technology in offline and online classes.
- Make effective presentations in seminars and conferences.
- Deliver lectures and facilitate discussions and other activities in the classroom situation.

Target Audiences

The course is designed as a compulsory course for the research scholars of all disciplines. However it may be useful for students of the masters programmes who may be taking this course as an elective to enhance their employability.

Prerequisite

The prerequisite for the course is a bachelor's degree in any discipline.

Course Content

- 1. Overview of Teaching and Learning (6 hours)**
 - a. Concept of Pedagogy, Andragogy and Heutagogy
 - b. Understanding Teaching and related terms, the relationship with learning
 - c. Understanding learner and learning cycle
 - d. Taxonomy of teaching objectives (Revised Bloom's taxonomy),
 - e. Writing learning outcomes
- 2. Curriculum and Instruction (8 hours)**
 - a. Curriculum: Concept and Facets,
 - b. Credit Framework and Choice-based Credit System
 - c. Instruction: Concept, Design and instructional media
 - d. Developing Instructional Plans
- 3. Teaching Strategies and Approaches (9 hours)**
 - a. Expository vs Inquiry Strategy (shifting from behaviourism to constructivism)
 - b. Individualized to small group/ large group Approaches,
 - c. Scenario-Based, Online and Blended Approach, Introduction of MOOCs
 - d. Designing Learning Events and Activities for Student Engagement
 - e. Component of effective lectures delivery
- 4. Pedagogical skills and tools (8 hours)**
 - a. Concept of TPACK
 - b. Pedagogical Skills - Scanning the class, starting a session, skill of achieving closure skills, skills to lead session, Skill to secure attention (switch over), scaffolding skills, time management, skill to handle challenging situations.
 - c. Technological Skills- Using different apps and platforms for teaching, Use of Open Educational resources (OER), developing assignments and learning material using different apps and software
 - d. Communication skills - Presenting in Public, Participating in Discussions and Formal Meetings
- 5. Assessment and Evaluation (8 hours)**
 - a. Concept of Assessment, Assessment for learning, of learning, as learning,
 - b. Receiving and Giving Feedback
 - c. Assessment rubrics, Assessment Portfolio, Reflective journal

- d. Designing an Achievement test - Objective and Descriptive / Open book question paper
- e. Grading System (Absolute, Relative, CGPA, Conversion of grades to percentage etc)
- f. Conducting Examination, - Face to Face, Online Exams (Proctored and non-Proctored Exams)
- g. Project Reviews and Viva-Voce Examinations

6. Classroom Management (6 hours)

- a. Organizing the Physical environment
- b. Managing learner's behaviour through action research
- c. Counselling, Guidance and Mentoring
- d. Effective Academic leadership
- e. Resource Management

Mode of Transaction

The content will transact through interactive lectures, activities, web lectures, assignments, discussions and seminars and practice sessions (video recorded to provide feedback).

Assessment: CIA and EoSE as per provisions of the university ordinances

NEW COURSE on Pedagogy for Higher Education DESIGNED by Dr Anjali Sharma and reviewed by following five experts from Education Domain:

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