



SYLLABUS
FOR
FOUR YEARS UNDERGRADUATE PROGRAMME
IN
PHYSIOLOGY
Curriculum and Credit Framework for Undergraduate Programmes
(CCFUP) Based on NEP 2020

With effect from the Academic Session 2026-2027



BANKURA UNIVERSITY
BANKURA
WEST BENGAL
PIN 722 155

SEMESTER-VII

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
S/PHY/ 701/MJC-17	MJCT-17: Ergonomics and Sports Physiology	3	10	25	50	3	NA	
	MJCP-17: Ergonomics and Sports Physiology Lab	1		15				2
S/PHY/ 702/MJC-18	MJCT-18: Instrumentation	3	10	25	50	3	NA	
	MJCP-18: Instrumentation Lab	1		15				2
S/PHY/ 703/MJC-19	MJCT-19: Genetics, Molecular Biology and Biotechnology	3	10	25	50	3	NA	
	MJCP-19: Genetics, Molecular Biology and Biotechnology Lab	1		15				2
S/PHY/ 704/MJC-20	MJCT-20: Research Methodology and Research Ethics	4	10	40	50	4	NA	NA
S/PHY/ 705/MN-7	MNT-7: Microbiology and Immunology	3	10	25	50	3	NA	
	MNP-7: Microbiology and Immunology Lab	1		15				2
Total in Semester – VII		20	50	240	300	18		04

N.B. MJC – Major Core, MN – Minor. Theory: - 1 Credit= 1 hour/Week, Practical: - 1 Credit= 2 hours/Week, Tutorial: - 1 Credit= 1 hour/Week

3.33 MJCT-17: Ergonomics and Sports Physiology

Course Code: S/PHY/701/MJC-17

Course ID:72511

[Theory: Credits 3 (3 Lectures/Week)/ Marks 25]

3 Credits

Course Learning Outcomes:

- ✓ Students will gain their knowledge on Ergonomics and Sports Physiology.
- ✓ From this core course students will develop their knowledge about physiological work load, concept of work rest cycle and its significance.
- ✓ This course describes human body systems and their responses to physical activity and work environments.
- ✓ Students will be able to analyze workplace and sports settings using ergonomic principles.
- ✓ This course will fortify our student to develop their knowledge on physiological work and endurance activity.
- ✓ Learner will learn about role of exercise and training on health and wellbeing.
- ✓ Student will able to asses cardiovascular, respiratory, and muscular responses during different grades of exercise.
- ✓ This course also helps to interpret physiological data such as O₂ debt, VO₂ max, heart rate, BP, and energy expenditure.

Ergonomics

1. **Introduction to Ergonomics:** A brief history of Ergonomics. Definition and scope of Ergonomics. Multidisciplinary approach to Ergonomics. Application of Ergonomics. Role of Ergonomics in health safety and productivity.
2. **Human machine interaction:** Introduction to man machine interaction and interfaces. Fundamentals of human computer interaction. Fundamental idea of display and control man-machine-environment interaction. User interface and control display compatibility.
3. **Anthropometric considerations in Ergonomics:** Definition of anthropometry. Common terminologies used in anthropometry, landmarks for its management. Process of different body dimensions measured in anthropometry. Static anthropometry. Brief ideas about application of anthropometric data in design. Somatotyping.
4. **The work place:** Workplace components. Work place stressors and work place risk factors. Physical work environment: (a) Thermal environment, its' effect, Heat stress indices, (b) Noise and vibration, its' effect on workers. Occupational deafness, (c) Illumination level and its' effect on visual performances, (d) Ergonomic principles of control of Physical hazards.
5. **Ergonomic principles of work load handling:** Classification of Physiological work load. Concept of work rest cycle and its significance. Ergonomic principles of safe load handling.

6. **Occupational health hazards:** Importance of ergonomics in occupational health and well-being. Occupational diseases: Pneumoconiosis, Asbestosis, Silicosis and work-related musculoskeletal disorders. Prevention of accident and concept of industrial safety.

Sports Physiology

1. **Introduction on Exercise and Sports Physiology:** Definition and types of work and exercise physiology. Fundamental concepts of work. Different categories of work and work load. Physiological work - Isotonic, isometric, isokinetic, positive and negative. Brief idea on muscular power, strength, endurance and performance.
2. **Muscles:** Types and fiber classification and their role in sports. Effect of over exercise on muscle.
3. **Bioenergetics:** Work power and energy sources of energy. Basic concept of bioenergetics. Energy sources during exercise (Phosphagen, anaerobic and aerobic system). Aerobic and anaerobic capacity, Lactate threshold, lactate tolerance and their limitations. Determination of energy cost by direct and indirect methods.
4. **Exercise and Physical fitness:** Importance of regular exercise in health and wellbeing. Cardio-respiratory responses during different grades of exercise. Basic idea on sports rehabilitation and sports medicine.
5. **Physical Working Capacity:** O₂ debt. Concept of excess post-exercise oxygen consumption (EPOC). Physiological fatigue and recovery. Anaerobic and aerobic work. Concept of maximal physical working capacity, VO₂ max, and its estimation by different methods. Factors affecting VO₂ max and its application.
6. **Training:** Principles of physical training, training to improve aerobic and anaerobic power. Warmup and cool down in sports events. Effects of overtraining and detraining. Sports injury and its management.
7. **Sports Nutrition:** Pre-game, intra-game and post-game meals and their nature and importance. Female athlete triad. Nutrition care of female athletes. Nutritional supplements in exercise and sports, Ergogenic aids – Definition, types and their importance on physical performance. Doping- Brief concept. Sports drink. Glycogen loading on sports performances.

3.34 MJCP-17: Ergonomics and Sports Physiology Lab

Course Code: S/PHY/701/MJCP-17

Course ID: 72521

[Practical: Credit 1(2 Practical Classes/Week)/Marks 15]

1 Credit

Course Learning Outcomes:

- ✓ Students will acquire hands-on experience in measuring common anthropometric parameters in sitting and standing posture and calculate Body Surface Area (BSA) and Body Mass Index (BMI) using nomograms.
- ✓ Students will develop practical skills to measure working heart rate using the ten-beat method and interpret cardiovascular responses during physical activity.
- ✓ Students will learn to measure and compare blood pressure before and after different grades of exercise to assess circulatory adjustments to workload.
- ✓ Students will develop competency in assessing environmental stress by measuring Wet Bulb Globe Temperature (WBGT) index and noise levels using standard instruments.
- ✓ Students will gain the ability to record recovery heart rate and evaluate cardiovascular fitness using standardized exercise protocols.
- ✓ Students will learn to determine Physical Fitness Index (PFI) using the Harvard Step Test and estimate aerobic capacity through the Queen's College Step Test.
- ✓ Students will acquire skills in measuring body fat percentage, endurance time using hand grip dynamometer, and functional capacity through the Six-Minute Walk Test.

Ergonomics

1. Measurement of some common anthropometric parameters in standing and sitting posture – Stature, eye height, shoulder height, elbow height, knee height, arm reach from wall. Measurement of circumference – Head circumference, chest circumference, mid upper arm circumference (MUAC), waist circumference, hip circumference and thigh circumference.
2. Determination of BSA from anthropometric data using Du-Bois nomogram chart and BMI measurement.
3. Measurement of WBGT indices.

Sports Physiology

1. Measurement of blood pressure before and after different graded of exercise (Duration dependent recording).
2. Recording of recovery heart-rate and respiratory rate after moderate exercise (Graphical presentation of data for 5 minutes at 1 minute interval).
3. Assessment of Physical Fitness Index by Harvard Step Test (Modified).
4. Measurement of body fat percentage by skin fold method.
5. Determination of endurance time by hand grip dynamometer.
6. Determination of VO_2 max by Queen College Step Test.
7. Six-minute walk test for assessment of cardio-pulmonary strength.

Suggested Readings

1. Fitting the Task to the Man: A Textbook of Occupational Ergonomics. KHE Kroemer and E Grandjean. Taylor and Francis.
2. Engineering Physiology: Bases of Human factors / Ergonomics, KHE Kroemer and HB Kroemer. Van Reinhold.
3. Bodyspace: Anthropometry, Ergonomics and Design. S. Phesant, Taylor and Francis
4. Human Factors in Engineering. EJ McCormick and H Saunders. 5th Edition. McGraw-Hill.
5. Ergonomics Man in His working Environment. Murrell K. 3rd Ed. Springer.
6. Introduction to Ergonomics, R.S. Bridger, Routledge: Taylor & Francis group
7. Exercise Physiology: Theory and Application to Fitness and Performance. S.K. Powers and E.T. Howley. 10th edition. McGraw Hill publishers.
8. Exercise Physiology: Nutrition, Energy, and Human Performance. W.D. McArdle, F.I. Katch and V.L. Katch. 7th edition. Lippincott, Williams & Wilkins publishers.
9. Physiology of Sport and Exercise. J. H. Wilmore, D. L. Costill, W. Larry Kenney. Human Kinetics
10. Textbook of Work Physiology: Physiological Bases of Exercise. Per- Olof Åstrand, Kaare Rodahl, Hans A. Dahl, Sigmund B. Strømme. Human Kinetics
11. Fox's Physiological Basis for Exercise and Sport by M. L. Foss. S. J. Keteyian, E. L. Fox, William C Brown Pub.
12. The Physiology of Work, K. Rodahl, Taylor & Francis.
13. Essentials of Exercise Physiology, V.L. Katch, W.D. McArdle, F.I. Katch, Wolters Kluwer.
14. The Physiological Basis of Physical Education and Athletics, by W.D. McArdle, F. Katch and V.L Katch. Williams and Wilkins.
15. The Text Book of Work Physiology by P.O. Astrand and K. Rodhal. McGraw-Hill Books Co.
16. Human Factors in Engineering and Design, by E.O. McCormick and M. Sanders. Tata McGraw Hill.
17. Sports Physiology, by E.L. Fox, Saunders College Publishing Holt-Saunders.
18. Dietary Supplements and Nutraceuticals. Mukherjee B. Springer Singapore; Hardcover ISBN 978-981-96-8621-6; Published: 22 August 2025.
19. Healing Beyond Blood Sugar-A Complete Guide to Managing Diabetes-Related Disabilities. Adhikary K. Banerjee P. Ganguly K (Eds). 1st Edition, Springer Singapore. 2026. ISBN-10: 9819589452; ISBN-13: 978-9819589456
20. Introduction to Food, Nutrition and Health Research. Nirmalya Kumar Sinha, Rama Das, Dibyendu Dutta and Sankar Kumar Acharya (Eds.) Vidya Kutir Publications, New Delhi. 2024. ISBN: 978-93-92403-43-9

3.35 MJCT-18: Instrumentation

Course Code: S/PHY/702/MJC-18

Course ID:72512

[Theory: Credits 3 (3 Lectures/Week)/ Marks 25]

3 Credits

Course Learning Outcomes:

- ✓ This course will provide the basic principle, working mechanisms of commonly used biological and biomedical instruments such as spectrophotometers, centrifuges, microscopes, and electrophoresis systems and their applications.
- ✓ Student will gather their knowledge about the operating principles, components, and applications of bio-potential recording instruments including RIA, ELISA, Western, Northern and Southern blotting techniques.
- ✓ Students will be able to interpret experimental data obtained from biological instrumentation and evaluate measurement accuracy, calibration, and error sources.
- ✓ They will be able to demonstrate safe handling, maintenance, and troubleshooting of laboratory and clinical biological instruments.

1. Introduction to Biomedical Instrumentation.
2. **Microscope:** Principles, application, advantages and disadvantages. Compound microscope, Phase contrast microscope, Fluorescence microscope, Confocal microscope, Transmission and Scanning Electron Microscope.
3. **Chromatography:** Principles, working procedure and application of chromatographic techniques – Paper chromatography, TLC, GC, LC, HPLC.
4. **Proton and carbon NMR, IR:** Principle and application in physiology.
5. **Electrophoresis:** Principles and method, application of agarose gel electrophoresis, SDS – PAGE.
6. **Centrifuges:** Working principle, types and its application. Importance of Ultracentrifugation.
7. **Laminar Air flow, Autoclave and Incubator:** Working principle, types and its applications.
8. **Immuno-reaction-based biomolecule measurement:** Principle and application of RIA, ELISA methods. Western, Northern and Southern blotting techniques.
9. **Polymerase Chain Reaction:** Principle, working procedure and application.
10. **Internal Imaging System:** Endoscopy, Colonoscopy, USG, CRO and Polygraph.
11. **Radiometry:** Geiger-Müller (GM) counter.
12. **Histotechnology:** Cryocut and Cryopreservation - Brief ideas and its application.
13. **FACS:** Principle and applications.

3.36 MJCT-18: Instrumentation Lab

Course Code: S/PHY/702/MJCP-18

Course ID: 72522

[Practical: Credit 1(2 Practical Classes/Week)/Marks 15]

1 Credit

Course Learning Outcomes:

- Students will be able to demonstrate the fundamentals of measurement systems, including static and dynamic characteristics of instruments.
- Students will be able to analyze the working principles of measuring instruments such as ammeters, voltmeters, bridges, and oscilloscopes.
- Understand signal conditioning, data acquisition systems, and basic digital instrumentation concepts.
- Students will be able to apply knowledge of instrumentation systems in process control applications.

Practical

1. Instrument calibration- Sensitivity, specificity and cross reaction testing by instrument (Reliability and validity testing). Levy-Jennings Plot for quality control of instruments.
2. Estimation of blood chloride (Silver nitrate method).
3. Colorimetric estimation of blood constituents: Inorganic phosphate (Fiske-Subbarow Method) and sugar (Folin-Wu method)
4. Estimation of serum protein (Biuret method, by plotting standard curve)
5. Demonstration-DNA gel electrophoresis (Agarose Gel). Chromatographic finger printing.
6. Demonstration of amino acids through paper chromatography and Rf value determination.

Suggested Readings:

1. R.S. Khandpu. Handbook of Biomedical Instrumentation. 3rd Edition, 2024. Publisher: McGraw Hill Education.
2. John G. Webster. Medical Instrumentation: Application and Design. 4th Edition, 2004 John Wiley & Sons.
3. Joseph J. Carr and John M. Brown . Introduction to Biomedical Equipment Technology 4th Edition, 2004. Pearson Education
4. Raghbir Singh Khandpur. Compendium of Biomedical Instrumentation (3 Volume Set). 1st Edition, 2019. Publisher: Wiley
5. Myer Kutz. Standard Handbook of Biomedical Engineering & Design. 1st Edition, 2003. McGraw-Hill
6. Das, D. Biophysics and Biophysical Chemistry. 5th Edition, 2004, Academic Publishers.
7. Roy, R.N. A. Text Book of Biophysics. New Central Book Agency (P) Ltd. 2015.

3.37 MJCT-19: Genetics, Molecular Biology and Biotechnology

Course Code: S/PHY/703/MJC-19

Course ID: 72513

[Theory: Credits 3 (3 Lectures/Week)/ Marks 25]

3 Credits

Course Learning Outcomes:

- ✓ Students will develop their knowledge on basic genetics, molecular biology and biotechnology.
- ✓ Students will be able to explain fundamental principles of genetics, including Mendelian laws, inheritance patterns, and chromosomal behavior.
- ✓ Students will be able to explain key concepts of Molecular Biology, such as DNA replication, repair, recombination, and genome organization.
- ✓ Learners will enrich their ideas about bacterial genetics.
- ✓ This course will strengthen our students with in-depth on crossing over, linkage, gene mapping and SNP analysis.
- ✓ This core course will provide the learner better idea on basic concept of molecular biology and biotechnology.
- ✓ Students will be able to integrate interdisciplinary knowledge to solve biological problems related to heredity, gene function, and biotechnology applications.

Genetics

1. Basic principles of genetics
2. Basic concept of chromosomes. Organisation of chromatin. Chromosomal rearrangement in health and disease, mechanism of chromosomal recombination, karyotyping, hyperchromatism and hypochromatism. Crossing over and Linkage.
3. Extension of Mendelism - Epistasis and its different types present in animals. Penetrance, expressivity, pleiotropism. Numerical and structural variations in chromosome - Basic concepts of aneuploids and polyploids.
4. Human cytogenetics in brief and its use in medical science.
5. Chromosomal aberrations, agents and types of gene mutation (Transition, transversion, deletion, duplication, inversion, insertion, frame-shift mutation, non-sense, mis-sense mutation), banding technique, inborn errors of metabolism.
6. Sex determination and sex linkage.

Molecular Biology

1. Basic concept of molecular biology.
2. Gene amplification, coding and noncoding sequences, oncogenes and properties on cancer cells. Central Dogma of genetics. Regulation of gene expression: Operon Concept – Lac Operon in brief.
3. DNA replication - Meselson and Stahl Experiment Antiparallel and Semiconservative Replication Model, DNA polymerases, ligases and other regulatory proteins, prokaryotic and eukaryotic replications, tandem-gene cluster.
4. Transcription - RNA polymerase and other regulatory mechanism in prokaryotes. Organization of transcriptional units. Induction, repression and attenuation. Exons, introns, post-transcriptional modification and splicing, role of ss-RNA.
5. Translation - Genetic code and its properties, Wobble hypothesis, codon-anticodon interaction, translation in prokaryotes, post-translational modification and amino acid sequencing in proteins.
6. DNA damage and repairing. Gene Mapping and SNP analysis.

Biotechnology

1. Introduction to Biotechnology, branches of biotechnology and their application.
2. Gene therapy, transgenic animal – General concept.
3. Fermentations and their use, biofermenter, genetic engineering.
4. Recombinant of DNA - Technology and its applications. Mobile genetic element, Rec protein, gene library, gene therapy, gene splicing, restriction endonucleases, restriction mapping, chromosomal walking.
5. Cloning, cloning vectors, plasmid and cosmid.
6. Basic idea and its application of Bioinformatics in Biotechnology. Idea about primer design.
7. DNA fingerprinting and its application in forensic science, Short Tandem Repeat (STR) in DNA profiling. Nucleic acid sequencing, next generation sequencing. RT-PCR and qRT-PCR: Principle, and their applications.

3. 38 MJCP-19: Genetics, Molecular Biology and Biotechnology Lab

Course Code: S/PHY/703/MJCP-3

Course ID: 72523

[Practical: Credits 1(2 Practical Classes/Week)/Marks 15]

1 Credits

Course Learning Outcomes:

- ✓ Students can perform basic genetic experiments, such as Mendelian inheritance analysis and pedigree interpretation.
- ✓ Isolate and purify nucleic acids (DNA/RNA) from various biological samples using standard protocols.
- ✓ Quantify and assess the quality of nucleic acids using spectrophotometry and gel-based methods.
- ✓ This practical course will provide wide range of knowledge about retrieval of amino acid sequence from mRNA.
- ✓ Students will gain their knowledge on retrieval of codogen in DNA from codonsequence of mRNA.
- ✓ The discipline specific elective course will fortify the students to develop theirskill about extraction of DNA and RNA from supplied sample.
- ✓ Learner will gain their skill about quantification of DNA, RNA and protein

Practical

1. Retrieval of amino acid sequence from mRNA.
2. Retrieval of codogen in DNA from codon sequence of mRNA.
3. Genomic DNA extraction from supplied sample using kit.
4. Estimation of DNA by diphenyl amine method.
5. Agarose gel electrophoresis of DNA and molecular size determination from supplied graph.
6. Demonstration of Primer designing and BLAST.
7. Quantification of Protein by using Bradford method.
8. Determination of molecular weight of protein from supplied chromatographic record.
9. In vitro culture – Cell suspension, Washing and sterilization, Preparatory steps for tissue culture, basic procedures for aseptic tissue transfer, incubation of culture (Demonstration)
10. Demonstration of PCR, RT-PCR, Western blotting.
11. Visit to Higher Institutional Laboratory and submit a report (compulsory).

Suggested Readings:

1. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology,
2. David Freifelder. (2008). Molecular Biology. 2nd Edition. Narosa Publishing House.
3. Goodman & Gilman's The Pharmacological Basis of Therapeutics With DVD
4. (Goodman and Gilman)"S the Pharmacological Basis of Therapeutics. 12th Edition.
5. (2011).
6. Berk, A. Kaiser, C.A. Lodish, H, Amon, A. (2016). Molecular Cell Biology
WH Freeman.
7. Wilson, K. and Walker J. (2010). Principles and Techniques of Biochemistry and
8. Molecular Biology. Seventh Edition.
9. Gardner, E.J. Simmons, M.J, Snustad, D.P. (2006) Principles of Genetics. 8th Edition. Wiley.
10. Ozsoz, M.S. (2012). Electrochemical DNA Biosensors. Pan Stanford Publishing Pte
Ltd
11. Simmons, S. (2006). Principles of Genetics. Fourth Edition. Wiley Asia Student
Edition.
12. Claverie, J.M. (2003). Bioinformatics for Dummies. 2nd Edition, Wiley.
13. Durbin, R. Eddy, S. Krogh, A. Mithchison, G. (2007). Biological sequence Analysis.
Cambridge University Press.
14. Guo, P, Haque., F. (2015). RNA Nanotechnology and Therapeutics (Methods in
Molecular Biology). CRC Press Taylor and Francis.
15. Dutta, P.K. Dutta J. (2016). Multifaceted Development and Application of
Biopolymers for Biology, Biomedicine and Nanotechnology (Advances in Polymer
Science). Springer.
16. Ghosh, J. Mallick B. Bioinformatics: Principles and Applications. Springer.
17. Rastogi S.C. Mendiratta, N. Rastogi, P. (2013). Bioinformatics: Methods and
Applications: Genomics, Proteomics and Drug Discovery. Fourth Edition
18. Mount, David W. (2005). Bioinformatics: Sequence and Genome Analysis
19. Francis Ouellette, B.F. Baxevanis, A.D. (2009). Bioinformatics. 3rd Edition. Wiley.
20. Ananthanarayan, R. Kapil, A. A & P Textbook of Microbiology. 9th Edition.
21. Farzad Taghizadeh-Hesary, Sumel Ashique, Babak Behnam, Maria Vliora (Eds)
Mitochondria and Cancer. 1st Edition - March 1, 2026. Paperback ISBN: 9780443405358.
eBook ISBN: 9780443405365. Elsevier.
22. Kuladip Jana. The Role of Reactive Oxygen Species in Health and Disease. Nova Science
Publication. USA, 12th February, 2024. ISBN: 979-8-89113-283-2.
<https://doi.org/10.52305/TRSI2511>

3.39 MJCT-20: Research Methodology and Research Ethics

Course Code: S/PHY/704/MJC-20

Course ID:72514

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Course Learning Outcomes:

- Students will develop their basic knowledge and critical thinking.
- Students will be able to choose suitable methods of research aims and objectives.
- It will cover the methodology and theory of statistics as applied to problems in the field of biological sciences.
- The course will provide the basic understanding and application of statistics as a tool for testing hypothesis and experimental design for research studies.
- Students will be able to apply ethical principles in research work.

1. Foundation of Research

Meaning, objectives, and motivation of research. Types of research: Basic/fundamental, applied and action research, qualitative and quantitative research, experimental and quasi experimental research. Research approaches, significance of research, research methods versus methodology, research variables (Control, randomization, replication. concept of independent and dependent variables) and criteria of good research.

2. Defining the Research Problem

Origin, concept and need, Identification of research problem, defining and delimiting of research problem.

3. Research Questions and Hypothesis – Research questions – Investigation questions, Measurement issues, hypothesis – Characteristics of a good hypothesis, Null hypothesis and Alternative hypothesis. Hypothesis testing – Logic and importance.

4. Research Design: Meaning of research design, needs for research design, features of a good research design, important concepts relating to research design, types of research design: Concept and uses of exploratory, descriptive, cross-sectional, longitudinal. Developing a research plan: problem identification, experimentation, determining experimental and sample design, working a proposal - review of literature.

- 5. Measurement and Scaling Techniques:** Concept of measurement, Scales of measurement – Nominal, ordinal, interval, ratio. Sources of error in measurement, quality control measurement – Validity, reliability and practicality. Meaning of scaling and scale classification bases.
- 6. Sampling:** Concepts of statistical population, sample, sampling frame, sampling error, sample size, non-response. Characteristics of a good sample. Probability sampling – Simple random sampling, stratified random sampling, multi-stage random sampling, cluster sampling and area sampling. Determining size of the sample – Practical considerations in sampling and sample size. Non-probability sampling- Types and examples.
- 7. Types of Data:** Primary and secondary, qualitative and quantitative, Data collection tools: Questionnaires, interviews, observation. Construction of questionnaires and schedules. Selection of appropriate methods for data collection. Case study method.
- 8. Data Processing and use of Statistical Technique in Data Analysis:** Data editing, coding, tabulation, graphical presentation of data and significance.
- 9. Research Tools and Publication:** Research Journals (type), research paper writing steps, paper formatting, criteria of good paper writing, report/thesis, reference type, criteria of good paper presentation. Data analysis software-SPSS and ORIGIN, Biological data base-NCBI, use of Encyclopaedia.
- 10. Ethics in Research –** Ethical Issue in Research, Plagiarism - Definition, different forms, consequences, unintentional plagiarism, software for plagiarism. Patent, Copyright, Trade Mark, collaborative work. Qualities of good Researcher. UGC guidelines on Research Ethics, Human and animal ethics in Physiological research.
- 11. Metrics of Research Quality Assessment:** Citation Index, impact factor, h-Index, i-10 index, g-index. (bold withdrawn)
- 12. Artificial Intelligence (AI):** AI in Research Methodology, preliminary idea and application of AI in Biological Research.

Suggesting Reading:

1. Kothari, C.R. Research Methodology: Methods and Techniques, New Age International Private Limited, 2004, New Delhi.
2. Ray, P.P. A Guide to Research and Publication Ethics, New Delhi Publishers, 2022, New Delhi.
3. Singh, R. Research Methodology in life Sciences, (Vol-I), Natals Publications, 2024, New Delhi.
4. Bajpai, N. Business Research Methods, 1st Edition, 2011, Pearson Education.
5. Chawla, D. and Sondhi, N. Research Methodology: Concepts and Cases, Vikas Publishing House, 2016, New Delhi.
6. Das and Malhotra. Marketing Research, 7th edition, 2019, Pearson Education, New Delhi.
7. Rubin, A. and E.R. Babbie. Research Methods for Social Work, 2017, Cengage Learning.
8. Sharma, J. K. Business Statistics, Pearson Education, 2014.



4.0 Minor (MN) Courses

4.13 MNT-7: Microbiology and Immunology

Course Code: S/PHY/705/MN-7

Course ID:72516

[Theory: Credits 3 (3 Lectures/Week)/ Marks 25]

3 Credits

Course Learning Outcomes:

- ✓ Students will learn the fundamental concepts of Microbiology and Immunology, including the structure, classification, and function of microorganisms such as bacteria, viruses, fungi, and parasites.
- ✓ Students will be able to identify pathogenic microorganisms and explain mechanisms of microbial pathogenesis, host-pathogen interactions, and disease transmission.
- ✓ Students can apply laboratory techniques used in microbiology, such as microscopy, staining methods, culturing, sterilization, and antimicrobial susceptibility testing.
- ✓ Understand the human immune system, including innate and adaptive immunity, immune cells, tissues, and organs.
- ✓ Students will be able to analyze principles of vaccination and immunization, including vaccine types, mechanisms, and public health significance.
- ✓ Students can interpret diagnostic methods used in microbiology and immunology, such as serological tests, molecular techniques (e.g., PCR), and immunoassays.

Microbiology

1. Introduction to Microbiology:

Scope and history of microbiology. Classification of microorganisms: Fungi, algae, protozoa, bacteria and viruses. Historical perspectives on development of microscopic identification of microorganisms.

2. **Viruses:** Definition, structure. Types - DNA and RNA virus. Lytic and lysogenic cycle. Viroids and Prions. Bacteriophages.
3. **Bacteria:** Structure and morphological classification. Gram positive and Gram negative and acid-fast bacteria. Pathogenic and non-pathogenic bacteria, beneficial bacteria.
4. **Growth and nutritional requirements of bacteria:** Growth requirements for bacteria, micro and macro nutrients, nutritional types of bacteria. growth curve, factors affecting growth curve, environmental influences on growth. Basic concept of Quorum sensing and biofilm.
5. **Bacterial genetics** – Conjugation, transformation and transduction. F factor.
6. Elementary idea of bacteriostatic, bactericidal agents, antibiotics, antibiotic resistance and sensitive bacteria.
7. Basic concept of COVID-19, causative agents, transmission, pathogenesis, signs and symptoms, antiviral therapy, antiretroviral therapy (ART).

8. Preventive measures for travel related infectious disease, nosocomial infections-source, control, prevention and surveillance.

Immunology

1. **Immune system-An introduction:**

Definition and immune organs (Primary and secondary). Elementary knowledge of innate and acquired immunity, Humoral and cell mediate immunity, and artificial immunity and herd immunity. Immunoglobulin- Structure, types, features and functions; idea of immunogen, antigen, hapten and adjuvant.

2. **Vaccination and vaccine strategies:**

Principles, Universal protocol on Immunization-brief idea, primary and secondary reaction of vaccination, health reaction due to vaccination, memory cell formation due to vaccination and importance of immunization and concept on booster dose.

3. **Hypersensitivity reaction:**

Definition and types of hypersensitivity reactions, inflammation, structure and function of MHC – I and MHC –II, cytokines, chemokines in brief.

4. **Immunological methods/techniques:** Antigen-antibody reactions, precipitation and agglutination reaction, titre, ELISA, immunofluorescence, immunosuppression, monoclonal antibody.

5. **Autoimmunity:**

Definition, types and immunological disorders (Basic mechanism of type I diabetes, Hashimoto disease, SLE, Myasthenia gravis, Graves' disease etc.).

4.14 MNP-7: Microbiology and Immunology Lab

Course Code: S/PHY/705/MN-7

Course ID:72526

[Practical: Credit 1(2 Practical Classes/Week)/Marks 15]

1 Credit

Course Learning Outcomes:

- Students can demonstrate safe laboratory practices, including aseptic techniques, proper handling of microorganisms, and adherence to biosafety guidelines.
- Students will be able to isolate and culture microorganisms using appropriate media and incubation conditions.
- Apply sterilization and disinfection methods, including physical and chemical techniques.
- Students can carry out basic immunological techniques, such as antigen-antibody reactions, agglutination, precipitation, and ELISA-based assays.

Practical

1. Gram staining of bacteria and identification of Gram positive and Gram-negative bacteria.
2. Blood grouping and Rh typing.
3. Demonstration: Spore staining, Acid-fast staining of bacteria and Radial immuno-diffusion (RID).
4. Demonstration of antibody by Ouchterlony double diffusion technique and single radial immunodiffusion.

Suggested Readings:

1. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V. Jackson R.B. (2008). Biology. Pearson Benjamin Cummings, USA. 8th edition.
4. Das, D. Handbook of Practical Microbiology, Cell Biology Genetics and Biometry. Academic Publishers.
5. Ananthanarayan, R. Kapil, A. A & P Textbook of Microbiology. 9th Edition.
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