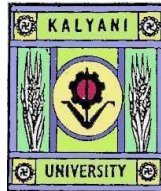


Syllabus for Ph.D Course Work (One Semester) in Physiology

(w.e.f. 2021)



**Department of Physiology
UNIVERSITY OF KALYANI**

Course-work :

1. The credit assigned to the six (6)- month duration (one semester) Ph.D. course work shall be of sixteen (16) credits.
2. The course work shall be treated as prerequisite for Ph.D. preparation. Eight credits (08) shall be assigned to the courses on Research Methodology which could cover areas such as quantitative methods, computer applications, research ethics and review of published research in the relevant field, training, field work, etc. Other courses shall be advanced level courses preparing the students for Ph.D. degree. Eight credits (08) shall be assigned to those advance level courses.
3. Each Ph.D. student will have to undergo one Semester course work of six-month duration. Number of papers, breakup of marks and credits of the said course work shall be as follows: –

Paper	Name of the Paper/Course item	Marks	Credits
01- RM/A.	Research Methodology (A)*	100 (60+20+20) (Term End. Examn.+Internal Assessment +Viva- voce)	04
02- RM/B	Research Methodology (B)	100 (60+20+20) (Term End. Examn.+Internal Assessment +Viva- voce)	04
03- ALC/A	Advance Level course on Subject (A)	100 (60+20+20) (Term End. Examn.+Internal Assessment +Viva- voce)	04
04- ALC/B	Advance level course on subject (B)**	100 (60+20+20) (Term End. Examn.+ Internal Assessment +Viva-voce)	04
	Total	400	16

* This course will be conducted faculty wise.

** one subject shall be chosen from a group of transdisciplinary recognized subjects

01- RM/A : Research Methodology (A)

Credit :04

Lecture Hours :60

Course content: Quantitative methods, Computer Applications, Research Ethics, Training, Field work, etc.

02- RM/B : Research Methodology (B)

Credit :04

Hours :60

Course content: Review of published research, Documentation/ submission of Reports on review work and presentation.

03- ALC/A : Advance Level course on Subject (A)

Credit :04

Lecture Hours : 60

3.1 RECENT DEVELOPMENTS IN PHYSIOLOGY

Course Contents : Structure and functions of skeletal, cardiac, and smooth muscle at cellular and molecular levels; innervations of heart, lung and intestine; stem cells, blood corpuscles, platelets, neurons and glial cells, blood brain barriers, reproductive cells and gametes, nephrons; cellular and molecular basis of receptors and ion channels; physical and biochemical principles involved in physiology, metabolism and hormone action. System functions- neuronal, respiratory, muscular, gastrointestinal, endocrine, reproductive; EPP, post tetanic potentiation, summation, stretch and inverse stretch reflex, dynamic and static responses of nerves, unit nerve discharge, functions of brain- hypothalamus, basal ganglia, cerebellum and neocortex, physiology of pain, emotion and memory, Alzheimer's disease, Parkinson's disease, posture and equilibrium, vision, hearing, taste and smell physiology, autonomic neurophysiology, lung volumes, lung function tests, lung compliance, principle of ergonomics and exercise physiology, Occupational and public health, human and environment.

3.2 RESEARCH METHODOLOGY IN PHYSIOLOGY:

Course Contents : (i) Basic, clinical and applied physiological research; laboratory based research, field studies and survey research. Designing of Physiological experiments- basic principle, guidelines for designing experiments, designing animal and human experiments, control, sham control (vehicle control) and experimental groups; acute, subacute, chronic and subchronic exposure; toxicological research methods- methods for determining LD₅₀ (LC₅₀), LOAEL, NOEL, mode of exposure-gavages oral ingestion, subcutaneous, intramuscular, intravenous etc. Emerging issues in occupational health and safety. Bioethics and animal maintenance, animal anaesthetization and animal killings. National ethical guidelines for biomedical and health research

involving human participants.

(ii) Methodologies – Advanced Physiological, experimental physiological, neuromuscular, respiratory, cardiovascular, haematological, reproductive and endocrinological, ergonomical, exercise physiological, histological and histochemical, microbiological, immunological, and molecular physiological methods for research. Electrophysiological techniques, Polyrite based electrophysiological and muscle experiments; ECG, EMG, EEG; microtomy and cryotomy, immunohistochemistry, morphometric analysis, microscopy, SEM, TEM, absorption spectroscopy (UV, visible, IR), principle of NMR, X-ray crystallography, mass spectrometry; proteomics, colorimetry, ultracentrifugation, electrophoresis, chromatography, SDS-PAGE, PCR, RT-PCR, karyotyping, toxicological experiments- oxidative stress determining methods-preparation of microsomal, synaptosomal, and mitochondrial fractions, ETC studying methods; lung function tests, measurement of O₂ uptake capacity, anthropometric measurement, biomechanical study of posture-joint angle and curvature study, analysis of posture by OWAS, REBA, RULA, PATH, NIOSH equation, measurement of physical work capacity, determination of hearing intensity and heat stress indices, Cycle ergometry, treadmill principle and human experiments, environmental physiological experiments, heavy metals and the function of organs, estimation of identification micronutrients and micro organisms in environmental sample, isolation of plasmid and mutagenic DNA, amplified rDNA restriction analysis, isolation and pure culture of micro-organism, analytical methods in Physiology, enzymological techniques- enzyme isolation and purification-chromatography, HPLC.

(iii) Writing a research project- Preamble, the problem, objectives, study design, methodology of the study including experimental set up, probable research outcome, social relevance, references, recurring and non-recurring budgets; and work-plan during the tenure of project.

(iv) Concept of IPR, pre-requisites for filing a patent and granting patent in India, patent infringement, Indian Patent Act 1970 and its amendment.

3.3 PHYSIOLOGICAL STATISTICS :

Course Contents : Applications of statistics in physiology, physiological variables, parameters, data, sample mean and variable, degrees of freedom, standard normal distribution, statistical hypothesis, Dendrogram, statistical techniques for data analysis- ANOVA, paired and unpaired 't' test, P value, chi-square test, DMRT test, MANN-Whitney U test, post hoc test, disease incidence and prevalence, confounding factor, meta analysis, correction and correlation.

3.3 COMPUTER APPLICATIONS in PHYSIOLOGY :

Course Contents : (i) Web search-Importance of Internet for searching research literatures, use of internet and WWW, use of search engine like yahoo, google etc., use of science specific search engine on the internet like SCOPUS, SCIRUS, PUBMED etc. Spreadsheet tool-statistical data analysis-data storing, generating table, graphs, charts and other features, use of Microsoft Excel for physiological data analysis, Presentation tool-

introduction to presentation tools, making of research items for presentation in a meeting/seminar, Microsoft Power Point/open office/similar tools for presentation. Online research paper submission- modes and techniques, GenBank submission, registration and submission of papers for attending national and international conferences.

(ii) Bioinformatics- Introduction to physiological informatics, health informatics, predicting toxicity of xenobiotics/pollutants, predicting physiological function at the cellular and molecular levels.

Suggested Readings:

1. Review of Medical Physiology, William.F.Ganong, 26th Edition, McGrawHill Companies, Medical Publication, 2019.
2. Text book of Medical Physiology, Guyton & Hall, 14th edition, 2020.
3. Physiology, R.M,Berne, M.N.Levy, 7th edition, 2017.
4. Research Methodology-Methods and Techniques (New Age International, New Delhi), Kothari C. K. 4th Edition (2019), 2/e.
5. Design and Analysis of Experiments, Montgomery, Douglas C. 10th Edition (2019), 5/e, (Wiley India).
6. A field for science writers: The official guide of the National Association of Science Writers. Blum, Deborah and Mary Knudson, eds. 2nd Edition (2005). New York: Oxford University Press, 1997.
7. Scientific Papers and Presentations, Davis, Martha, 3rd Edition (2013) San Diego: Academic Press.
8. Laboratory Safety: Theory and Practice. Fuscaldo, AA, Erlick, BI, Hindman, B. New York: Academic Press, 1980.
9. Biological Instrumentation and Methodology, Bajpai, PK. New Delhi: S. Chand & Co. Lts. , 2006.
10. Fundamentals of Computers, Rajaraman, V, 6th Edition (2014).
11. Statistics in Biology and Psychology, Debajyoti Das and Arati Das, 6th Edition (2010), Academic Publishers, Kolkata, ISBN: 978-93-80599-04-5.

04- ALC/B : Advance level course on subject (B)

Credit :04

Lecture Hours :60

One subject shall be chosen from the group of transdisciplinary recognized subjects

4.1 MOLECULAR NEUROTOXICOLOGY

Course Contents : Neural innervations of skeletal muscle, intestine and heart; cholinergic, adrenergic and NANC transmission, myoneural transmissions, neurotransmitters, receptors, ions and enzymes involved in muscle contraction, gastrointestinal receptors, neurotransmitters involved, agonists and antagonists of neurotransmitters, toxicology-basic principles, toxicants-heavy metals, Bisphenol A (BPA), pesticides,

metalloids, food additives, other environmental toxicants. Cytotoxicity, genotoxicity, oxidative stress and antioxidant profile, intestinal motility and toxicity, toxicological histology and histochemistry, system toxicity.

Suggested readings:

1. Neurobiology, G.M.Shepherd, 3rd edition, 2005.
2. Principle of Toxicology, K.E.Stine, T.M.Brown, 3rd Edition, 2015.
3. Handbook on the toxicology of metals, G.F.Nordberg, B.A.Fowler, M.Nordberg, L.T.Friberg, 3rd Edition, 2007.

4.2 ENVIRONMENTAL PHYSIOLOGY

Course Contents : (i) Human and environment, ecology-ecosystem, food chain, mutualism, cooperation, parasitism etc., biomagnifications, environmental pollutions and health effects, arsenic pollution and human health, toxic substance pollution, biogeochemical cycles, biological N₂ fixation and human intervention, human population and environmental health, biological diversity-types, degradation, effects, bioremediation, public health concepts, indoor pollutions, reduction pollution and human health, effects of ozone screen depletion on human health, acid rain, enhanced green house effects and global warming, effects of climate change on human health, adaptation and mitigation strategies to prevent climate change effects.

(ii) Microbes in extreme environments- biodiversity, characteristics and biotechnological potentials, PGPR bacteria-habitat, diversity and importance, bacterial classification systems, Bergey's manual of systematic bacteriology, microbial ecosystems, methods of studying microbial diversity (conventional and molecular).

Suggested readings :

1. Fundamentals of Ecology, E.P.Odum, G.W.Barrett, 5th edition, 2005.
2. The science of Climate Change, Goutam Paul, July 2010.
3. A text book of Oceanography, Goutam Paul, April 2006.
4. Environmental Chemistry, Colin Baird, Michael Cann, 4th edition, 2008.
5. Environmental Microbiology, R.M. Maier, I.L. Pepper & G.P. Gerba, 2nd edition, Academic Press,2002.
6. Comprehensive Biotechnology, Murray Moo Young, Vol-4, 1985.
7. Biotechnology,Rehm and Reid, 2nd edition, 1993.
8. Microbial Ecology: Fundamentals and Applications, Atlas & Bartha, 4th edition, Pearson Education, 1998.
9. Environmental science, B. J. Nebel, R. T. Wright. 10th edition, 2008.
10. Microbial Diversity: Current perspectives and potential applications, eds. Satyanarayana Johri, IK International Pvt. Ltd. New Delhi, India, 2005.
11. Principles of Microbiology,Ronald M Atlas, 2nd edition,1997.

4.4 ERGONOMICS AND OCCUPATIONAL PHYSIOLOGY

Course Contents : Physical work capacity, ergonomic principles in design, occupational

ergonomics, extended working hours and shift work, Chronotypes physical and chemical aspect of work environment, psychological job demand and cognitive ability, check list and questionnaire design, Occupational Health hazards, ergonomics for safety and management. Analysis of risk, psychosocial health hazards. Concept of vision Zero. Productivity and workstudy.

Suggested readings :

1. The occupational ergonomics hand book, Marras, W.S and Karwowski, W (2006): (Vol I & II), Taylor and Francis, London.
2. Introduction to ergonomics (Third Edition), Bridger, R.S. (2009): CRC Press London.
3. Reese, C.D. (2009): Industrial Safety, and Health, CRC Press, London.
4. Fitting the Human (7th Edition), Kroemer, K.H.E (2017): CRC Press London.
5. Essentials of Exercise Physiology (Third Edition), McArdle, Katch F.I and Katch, V. L. (2008). Lippincott William & Wilkins, USA.

4.5 UNDERSTANDING CELL BIOLOGY

Course Contents : Basic, Clinical and Translational Research, Clinical Trials. Importance of study of cell cycle and cell death in health and disease. Cell cycle and its regulators. Mechanism of cell death- pathways of Apoptosis. Detection of modes of cell death. Regulators of cell death - role of oxidative stress in cell death and its detection. Importance of study of Cell survival, cellular adhesion and proliferation, its regulators and methods of detection (microscopy and other methods). Signal transduction in cells – Growth factors and receptor studies.

Suggested readings :

1. The Cell, A Molecular Approach, 8th edition, Geoffrey M Cooper (2019). Boston University. Sunderland (MA): ISBN-10: 0-87893-106-6.
2. Molecular Biology of the Cell, 6th edition, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D Watson(2014) New York: Garland Science; ISBN-10: 0-8153-1619-4.
3. Molecular Cell Biology, 9th edition, Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell (2021). New York: W. H. Freeman ISBN-10: 0-7167-3136-3.
4. Cell Death Techniques: A Laboratory Manual ,Edited by Ricky Johnstone, PhD, *Peter MacCallum Cancer Centre*; John Silke, PhD, *The Walter and Eliza Hall Institute* ISBN 978-1-621820-05-5.
5. Cellular Signal Processing: An Introduction to the Molecular Mechanisms of Signal Transduction, 2nd edition, Friedrich Marks, Ursula Klingmuller, Karin Muller-Decker (2017) Published by Garland Publishing.
6. Structure and Function in Cell Signalling, John Nelson, (2008), Wiley ISBN: 978-0-470-02551-2.