1. PROGRAM AND COURSE CODES OF Ph.D. ZOOLOGY

Program Code & Name	Program Code & Name (Pre-revised)	Program Code & Name (Revised)
PH8701Research Methodology	**Paper – I Research Methodology** Unit I : What is research & why do it? Basic and applied research; Deduction and induction reasoning in scientific methods; Thesis and hypothesis, dissertation Unit II : Planning research in animal science: Selection of field, definition of problem, is idea viable and practical, time factor, literature survey and development of bibliography, has it been done before, plagiarism, protocol of experiment: design, execution (methodology), Collecting data and presentation (Table, graphs, figures etc.,) and analysis, reporting in form of paper/thesis/dissertation Unit III: Safety measures in laboratory and research animal maintenance, Electrical equipments, Personal protection, Face masks, Hazards in laboratory chemical, ionizing agent and waste disposal, fist aid, maintenance of animals following ethical guidelines, disposal of dead animals Unit IV : Instrumentation: Microscopes-light, electron, phase contrast and dark field fluorescent microscopy : principles and applications-pH meter, Chromatography; electrophoresis, calorimetry/spectroscopy, Scintillation counters, Thermal cycler, DNA sequencers, GLC and HPLC, Laminar flow Unit V :	**PH8701Research Methodology** Unit I : What is research & why do it? Basic and applied research; Deduction and induction reasoning in scientific methods; Thesis and hypothesis, dissertation Unit II : Planning research in animal science: Selection of field, definition of problem, is idea viable and practical, time factor, literature survey and development of bibliography, has it been done before, plagiarism, protocol of experiment: design, execution (methodology), Collecting data and presentation (Table, graphs, figures etc.,) and analysis, reporting in form of paper/thesis/dissertation Unit III: Safety measures in laboratory and research animal maintenance, Electrical equipments, Personal protection, Face masks, Hazards in laboratory chemical, ionizing agent and waste disposal, fist aid, maintenance of animals following ethical guidelines, disposal of dead animals Unit IV : Instrumentation: Microscopes-light, electron, phase contrast and dark field fluorescent microscopy : principles and applications-pH meter, Chromatography; electrophoresis, calorimetry/spectroscopy, Scintillation counters, Thermal cycler, DNA sequencers, GLC and HPLC, Laminar flow Unit V : Principles and application of micro-techniques; fixation, embedding of tissues for Histological sectioning, Microtomes, Principles of

	Principles and application of micro-techniques; fixation, embedding of tissues for Histological sectioning, Microtomes, Principles of staining, different staining. Staining ; dehydraton, clearing agents, embedding, infiltration, mounting and mountants, cytochemical/histochemical methods to detect different chemical components (proteins, carbohydrates, lipids, nucleic acids, enzymes) of cells/tissue, enzyme histochemistry, immunohistochemistry Unit VI: Principles and application of biochemical methods: preparation of physiological solutions (Media for microbial and animal cell culture and tissue homogenization) and buffers, principles and application of electrophoresis, RIA, ELISA, DNA sequencing, PCR, GLC and HPLC Unit VII: Biostatistics: type of data and classification; Presentation of data; Tests of significant between two or more samples (both parametric and non-parametric), post-hoc tests, Correlation and regression, Chi-square statistics Unit VIII: Use of computers in biological research : Graphical data presentation; use of statistical packages (e.g SPSS) in data analysis; use of power point program in presentation of Research in conference/seminars **REFERENCES** Gurumani, N. Research Methodology for Biological Sciences, MJ Publishers. 2006 Hawkins, C. & sorgi, M. (eds). Research :	staining, different staining. Staining ; dehydraton, clearing agents, embedding, infiltration, mounting and mountants, cytochemical/histochemical methods to detect different chemical components (proteins, carbohydrates, lipids, nucleic acids, enzymes) of cells/tissue, enzyme histochemistry, immunohistochemistry Unit VI: Principles and application of biochemical methods: preparation of physiological solutions (Media for microbial and animal cell culture and tissue homogenization) and buffers, principles and application of electrophoresis, RIA, ELISA, DNA sequencing, PCR, GLC and HPLC Unit VII: Biostatistics: type of data and classification; Presentation of data; Tests of significant between two or more samples (both parametric and non-parametric), post-hoc tests, Correlation and regression, Chi-square statistics Unit VIII: Use of computers in biological research : Graphical data presentation; use of statistical packages (e.g SPSS) in data analysis; use of power point program in presentation of Research in conference/seminars **REFERENCES** Gurumani, N. Research Methodology for Biological Sciences, MJ Publishers. 2006 Hawkins, C. & sorgi, M. (eds). Research : How to plan, speak and write about it. Narosa Publ. New Delhi 1985 Marimuthu R. Microscopy and Microtechniques. MJPublisher. 2008 Pagano, R.R. Understanding statistics in the behavioral Sciences. IV Ed. West Publ. Co. NY. 1994

	How to plan, speak and write about it. Narosa Publ. New Delhi 1985 Marimuthu R. Microscopy and Microtechniques. MJPublisher. 2008 Pagano, R.R. Understanding statistics in the behavioral Sciences. IV Ed. West Publ. Co. NY. 1994 Plummer, D.T. An Introduction of Practical Biochemistry. Tata Mc Graw Hill Co. Ltd., New Delhi 1992 Sharma, V.K. Microscopy and Cell Biology. Tata Mc Graw Hill Co. Ltd., New Delhi 1992 Sokal, R.F. and Ralph, F.H. Biometry. W.H. Freeman, Sanfransisco 1995 Veerakumari, L. Bioinstrumentation. MJ Publishers 2006	Plummer, D.T. An Introduction of Practical Biochemistry. Tata Mc Graw Hill Co. Ltd., New Delhi 1992 Sharma, V.K. Microscopy and Cell Biology. Tata Mc Graw Hill Co. Ltd., New Delhi 1992 Sokal, R.F. and Ralph, F.H. Biometry. W.H. Freeman, Sanfransisco 1995 Veerakumari, L. Bioinstrumentation. MJ Publishers 2006
PH8702 GENERAL ZOOLOGY(Core-Subject)	**PAPER II (Core-Subject) : GENERAL ZOOLOGY** 48 hrs Unit : 1 – Animal Architecture : 06 a) Symmetry, body axis, major anatomical planes of sections, axis of polarity, surface to volume ratio, Tissues and their arrangements to form organs; organization of cell, cell surface. Unit : 2 – The history of life: 06 Record of history of life; knowing the age of rocks and fossils, decay of radioactive materials: origin of life; appearance of photosynthesizing organisms; eukaryotic cells; multi-cellular organisms: Cambrian; highpoints	**PH8702 GENERAL ZOOLOGY(Core-Subject)** 48 hrs Unit : 1 – Animal Architecture : 06 b) Symmetry, body axis, major anatomical planes of sections, axis of polarity, surface to volume ratio, Tissues and their arrangements to form organs; organization of cell, cell surface. Unit : 2 – The history of life: 06 Record of history of life; knowing the age of rocks and fossils, decay of radioactive materials: origin of life; appearance of photosynthesizing organisms; eukaryotic cells; multi-cellular organisms: Cambrian; highpoints of Paleozoic era; major events of Mesozoic era; mass extinctions; major events of coenozoic era

	of Paleozoic era; major events of Mesozoic era; mass extinctions; major events of coenozoic era to date. Unit : 3 – Animal and Environment: 12 Physiology and behavior in changing environment; tolerance; acclimatization; reproductive behavior and physiology, hibernation, migration, lunar and tidal rhythms and circadian rhythms Unit 4 : Recent trends in reproduction development : 12 Molecular cell boil and reproduction, stem cell biology, Regeneration, Pheramones Reproductive Technologies Unit 5 : Communication : 12 Sign and normal stimuli, Channels of communications; Pheromones and acoustic signals; Evolution of display and mimicry, aposematic coloration, deception and honesty; communication in social groups, alarm cells, alarm pheromones, trial pheromones; Dance language in honey bee; Primate Language **REFERENCES** 1. Schmidt-Nelson. Animal Physiology Adaptation and Environment (1990) 2. Barrington E.J.W. Invertebrate structure and function (1984) 3. J. Darnell, H. Lodish and D. Baltimore. Molecular Cell Biology (1986).	to date. Unit : 3 – Animal and Environment: 12 Physiology and behavior in changing environment; tolerance; acclimatization; reproductive behavior and physiology, hibernation, migration, lunar and tidal rhythms and circadian rhythms Unit 4 : Recent trends in reproduction development : 12 Molecular cell boil and reproduction, stem cell biology, Regeneration, Pheramones Reproductive Technologies Unit 5 : Communication : 12 Sign and normal stimuli, Channels of communications; Pheromones and acoustic signals; Evolution of display and mimicry, aposematic coloration, deception and honesty; communication in social groups, alarm cells, alarm pheromones, trial pheromones; Dance language in honey bee; Primate Language **REFERENCES** 1. Schmidt-Nelson. Animal Physiology Adaptation and Environment (1990) 2. Barrington E.J.W. Invertebrate structure and function (1984) 3. J. Darnell, H. Lodish and D. Baltimore. Molecular Cell Biology (1986). 4. Nancy M. Jessop. Theory and problems of Zoology(1988) 5. R. Mishell, Jr., Deajan and Loba Infertility, contraception and reproductive endocrinology(1991) 6. Scot Gilbert. Development Biology (2010) 7. Lewis Wilbert. Fundamentals of

	4. Nancy M. Jessop. Theory and problems of Zoology(1988) 5. R. Mishell, Jr., Deajan and Loba Infertility, contraception and reproductive endocrinology(1991) 6. Scot Gilbert. Development Biology (2010) 7. Lewis Wilbert. Fundamentals of development (1997) 8. Shashidhar. Animal biotechnology, MJP publications 9. Krebs, J.R. and Davies, N.B. An introduction to Behavioural Ecology, Blackwell Sci. Ltd (1993) 10. Slater, P.J.B. Essential of Animal Behaviour, Cambridge Univ. Press (1999) 11. Alcock J. Animal Behaviour, Sinaur Ass, USA (2009)	development (1997) 8. Shashidhar. Animal biotechnology, MJP publications 9. Krebs, J.R. and Davies, N.B. An introduction to Behavioural Ecology, Blackwell Sci. Ltd (1993) 10. Slater, P.J.B. Essential of Animal Behaviour, Cambridge Univ. Press (1999) 11. Alcock J. Animal Behaviour, Sinaur Ass, USA (2009)
PH8703Research ethics and Publication		PH8703Research ethics and Publication RPE 01: PHILOSOPHY AND ETHICS (3 hrs) 1. Introduction to philosophy: definition, nature and scope, concept, branches 2. Ethics: definition, moral philosophy, nature of moral judgments and reactions RPE 02: SCIENTIFICCONDUCT (5hrs.) 1. Ethics with respect to science and research 2. Intellectual honesty and research integrity 3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) 4. Redundant publications: duplicate and overlapping publications, salami slicing 5. Selective reporting and misrepresentation of data

RPE 03: PUBLICATION ETHICS (7 hrs.)		RPE 03: PUBLICATION ETHICS (7 hrs.) 1. Publication ethics: definition, introduction and importance 2. Best practices standards setting initiatives and guidelines: COPE, WAME, etc. 3. Conflicts of interest 4. Publication misconduct: definition, concept. problems that lead to unethical behavior and vice versa, Types 5. Violation of publication ethics, authorship and contributorship 6. Identification of publication misconduct complaints and appeals 7. Predatory publishers and journals PRACTICE
RPF. 04: OPEN ACCESS PUBLISHING (4 hrs.)		RPF. 04: OPEN ACCESS PUBLISHING (4 hrs.) 1. Open access publications and initiatives 2. SHERPA/ROMFO online resource to check publisher copyright & self-archiving policies 3. Software tool to identify predatory publications developed by SPPU 4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.
• RPE 05: PUBLICATION MISCONDUCT (4hrs.)		• RPE 05: PUBLICATION MISCONDUCT (4hrs.) A. Group Discussions (2 hrs.) 1. Subject specific ethical issues, FFP, authorship 2. Conflicts of interest 3. Complaints and appeals: examples and fraud from India and abroad B. Software tools (2 hrs.) Use of plagiarism software like Turnitin, Urkund and other open source software tools

RPE 06: DATABASES AND RESEARCH METRICS (7hrs)		RPE 06: DATABASES AND RESEARCH METRICS (7hrs) A. Databases (4 hrs.) 1. Indexing data bases 2. Citation databases: Web of Science, Scopus, etc. B. Research Metrics (3 hrs.) 1. Impact Factor of journal as per Journal Citation Report, SNIP. SJR, IPP. Cite Score 2. Metrics: h-index, g index, i10 index, altmetrics **References** Hird, A. (2006). /lulasuphy of Science. Routledge. MacIntyre. Alasdai (1967) 4 Sharr Henry UTEN. Tandu. P. Chaddah, (2018) fabic in Congreliure Rescurcb. Do not get scooped, do not 900 plagiarired, ISBN:97893874B0865 National Academy of Sciences National Academy of Engineering and Institute of Medicine. (2009). On Being a Kientist A Guide to Responsible Corcuar e Renconth Nurdian National Academies Press. Resnik, D. B. (2011). What is ellsics in research & why is it important. Nariww Inutile of Environmentar Health Sciences, 1-10. Retricved from het. Awww.delis naturresearch Tesources biocthies what is index.ch Beall, J. (2012). Prodalory publishers are corupting open access. Nauure 48974151 179.179. https.doi.org: 10.1038489179 Indian National Science Aciberry (INSA, Debics in Science Education Research and Curemance 2019. ISBN 978-81-999182-1-7. hun wwwinsindin osa-pal'Ethics Book INO"
	Paper III- Specialization Papers	
PH8704A Biology and Genetics of Drosophila		**PH8704A Biology and Genetics of Drosophila** 48hrs Unit I: 10 Introduction, *Drosophila* as a model organism in genetics, Collection methods, morphology, identification keys. General culture techniques, culture media; fly handling, Life cycle, factors affecting life cycle, Mass rearing of flies and mass production and harvesting of embryos. Unit II: 8 Reproduction and Circadian rhythms: male and female reproductive systems, Courtship behaviour, frequency dependent mating in *Drosophila*, fitness parameters. Non-sexual behaviour: sensory input, larval behaviour, foraging, pupariation, behaviour of *Drosophila* adults. Unit III: 5 *Drosophila* development: Axis formation, maternal effect genes, segmentation genes, homeotic selector genes.

		Unit IV: 15 Chromosomes, linkage and crossing over: Polytene and mitotic chromosomes; mutations; types of mutations; mutants, p-elements in *Drosophila*. Chromosome preparation techniques, staining and banding methods, In situ hybridization, FISH, Radio labeling techniques. Linkage and crossing over, Chromosomal and cytogenetic mapping, molecular mechanism of crossing over, gene conversion, recombination and evolution. Population genetics; Hardy-Wienberg law; factors affecting H-W law, genetic problems. Unit V: 10 Salient features of *Drosophila* genome: comparative and evolutionary genomics and proteomics, Nucleic acid and protein sequence databases; data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation. References 1. The Genetics and Biology of *Drosophila*. 1978. Vol. 2a. Edited by Michael Ashburner and T.R.F Wright. Academic Press, London. 2. The Genetics and Biology of *Drosophila*. 1978. Vol. 2b. Edited by Michael Ashburner and T.R.F Wright. Academic Press, London. 3. *Drosophila*, A guide to species identification and use. 2006. By T. A. Markow and P. M. O' Grady. Academic Press, London. 4. *Drosophila* Protocols. 2000. Edited by William Sullivan, Michael Ashburner and R. Scott Hawley. Cold Spring Harbor Laboratory Press, New York. 5. Developmental Biology. 2016. 11th edition By Scot F. Gilbert and Michael J. F. Barresi. Sinauer Associates Sunderland, M A. 6. Principles of Genetics. 2017. 7th edition by D. Peter Snustad and Michael J. Simmons. John Wiley and sons Inc.
PH8704B Development and Reproduction	**Development and Reproduction** Unit – I : An overview of development of zebra fish and frog – Fertilization, cleavage, gastrulation, organogenesis and hatching Unit – II :Early development of zebrafish and frog – Formation of germ layers, Molecular mechanisms of axis formation and its genetic control Unit – III : Emergence of ectoderm, mesoderm and endoderm and their derivatives Unit – IV : Postembryonic development – Growth, metamorphosis, regeneration and aging	**PH8704B Development and Reproduction** Unit – I : An overview of development of zebra fish and frog – Fertilization, cleavage, gastrulation, organogenesis and hatching Unit – II :Early development of zebrafish and frog – Formation of germ layers, Molecular mechanisms of axis formation and its genetic control Unit – III : Emergence of ectoderm, mesoderm and endoderm and their derivatives Unit – IV : Postembryonic development – Growth, metamorphosis, regeneration and aging Unit V : Environmental assaults on development, teratogens, endocrine disrupters, heavy metals and other factors Unit – VI : Germ cell development and reproduction in zebrafish and frog – Sex determination, differentiation, primordial germ cells, gonad formation, gametogenesis and reproduction

	Unit V : Environmental assaults on development, teratogens, endocrine disrupters, heavy metals and other factors Unit – VI : Germ cell development and reproduction in zebrafish and frog – Sex determination, differentiation, primordial germ cells, gonad formation, gametogenesis and reproduction **References** 1. Developmental Biology (IX Edition) ed. by Scott F. Gilbert (2010), Sinauer Associates Inc. USA 2. Principles of Development (II Edition) Lewis Wolpert (2002), Oxford Uni. Press, New York	**References** 1. Developmental Biology (IX Edition) ed. by Scott F. Gilbert (2010), Sinauer Associates Inc. USA 2. Principles of Development (II Edition) Lewis Wolpert (2002), Oxford Uni. Press, New York
PH8704C Environmental Biology	**Paper – III : Environmental Biology** Unit I : Environmental Pollution Introduction : pollutant; pollutant categories; Non-degradable pollutants; Biodegradable pollutants; Kinds of pollution; wastewater and sewage treatment; primary treatment; secondary treatment; tertiary treatment; Treatment and disposal of industrial effluents; solid waste treatment; waster recycling; Indian Environmental Protection Act 1986 Unit – II : Water Quality criteria and water pollution Introduction: Water quality standards; sources and effects of water pollution; sewage and domestic wastes, industrial wastes and effluents, pesticides, detergents and fertilizers, other chemicals, suspended solids thermal pollution, radioactivity; assessment and monitoring of water pollution; physico-chemical monitoring; biological monitoring, Macro invertebrates as biological indicator; Saprobian system (index); oligosaprobic, beta-mesosaprobic, alpha-mesosaprobic, plysaprobic, control of water pollution.	**PH8704C Environmental Biology** Unit I : Environmental Pollution Introduction : pollutant; pollutant categories; Non-degradable pollutants; Biodegradable pollutants; Kinds of pollution; wastewater and sewage treatment; primary treatment; secondary treatment; tertiary treatment; Treatment and disposal of industrial effluents; solid waste treatment; waster recycling; Indian Environmental Protection Act 1986 Unit – II : Water Quality criteria and water pollution Introduction: Water quality standards; sources and effects of water pollution; sewage and domestic wastes, industrial wastes and effluents, pesticides, detergents and fertilizers, other chemicals, suspended solids thermal pollution, radioactivity; assessment and monitoring of water pollution; physico-chemical monitoring; biological monitoring, Macro invertebrates as biological indicator; Saprobian system (index); oligosaprobic, beta-mesosaprobic, alpha- mesosaprobic, plysaprobic, control of water pollution. Unit – III : Toxicity Tests and Test Methodology Test conditions:Physical conditions; chemical conditions; biological conditions; toxicant concentrations Safety evaluation of toxicants: Risk management and monitoring; environmental hazards and risk assessment; criteria for safety evaluation; upper and lower confidence limits; cumulative toxicity; evaluation of combined toxicity of toxicant mixtures; toxicity evaluation of aquatic organisms and terrestrial organisms Unit – IV : Toxicity at the levels of organ systems Dermatoxicity; respiratory tract toxicity; gastrointestinal toxicity; hepatotoxicity; nephrotoxicity; cardiotoxicity; haematotoxicity; immunotoxicity; endocrine toxicity; reproductive toxicity; neurotoxicity

	Unit – III : Toxicity Tests and Test Methodology Test conditions:Physical conditions; chemical conditions; biological conditions; toxicant concentrations Safety evaluation of toxicants: Risk management and monitoring; environmental hazards and risk assessment; criteria for safety evaluation; upper and lower confidence limits; cumulative toxicity; evaluation of combined toxicity of toxicant mixtures; toxicity evaluation of aquatic organisms and terrestrial organisms Unit – IV : Toxicity at the levels of organ systems Dermatoxicity; respiratory tract toxicity; gastrointestinal toxicity; hepatotoxicity; nephrotoxicity; cardiotoxicity; haematotoxicity; immunotoxicity; endocrine toxicity; reproductive toxicity; neurotoxicity Unit – V : Pollutant induced Biochemical changes AchE inhibition; ATPase inhibition; changes in body lipid, protein and glycogen content; changes in ionic balance; effect on endocrine functioning; induced hematological changes; induced histophathological changes Unit – VI : Effects of Xenobiotics on reproduction and early development stages Residue in gonads and gametes Residue in early developmental stages Effects on reproduction and fecundity Effects on hatching and survival Unit VII: Uptake, Accumulation, biotransformation and Excretion of xenobiotics Uptake from the environment; metals and organics Transportation and accumulation of metals in	Unit – V : Pollutant induced Biochemical changes AchE inhibition; ATPase inhibition; changes in body lipid, protein and glycogen content; changes in ionic balance; effect on endocrine functioning; induced hematological changes; induced histophathological changes Unit – VI : Effects of Xenobiotics on reproduction and early development stages Residue in gonads and gametes Residue in early developmental stages Effects on reproduction and fecundity Effects on hatching and survival Unit VII: Uptake, Accumulation, biotransformation and Excretion of xenobiotics Uptake from the environment; metals and organics Transportation and accumulation of metals in different organs Regulation of metal concentration Glutathione and metal detoxification Infolvement of metallothionein in metal accumulation and acclimation to metals Bioconcentration of organic pollutant Biotransformation of organic contaminants Unit VIII: a. Alteration in cellular enzymes activity due to metal exposure b. Enzyme effects from organic chemical status c. Antioxidants and its impact d. Adenylates and its status e. Stress protein **REFERENCES** 1.Environmental Sciences by Santra 2.Environmental pollution by H. D. Kumar 3.Toxocology principles and Methods by M. A. Subramanyam 4.Toxicity of Pesticide of fish Vol. I & III, by A.S. Mourthy 5.Toxicology by Omkar 6.Water polltuon and Fish Physiology by Smith 7.Molecular Toxicology by Woods & Nelson

	different organs Regulation of metal concentration Glutathione and metal detoxification Infolvement of metallothionein in metal accumulation and acclimation to metals Bioconcentration of organic pollutant Biotransformation of organic contaminants Unit VIII: a. Alteration in cellular enzymes activity due to metal exposure b. Enzyme effects from organic chemical status c. Antioxidants and its impact d. Adenylates and its status e. Stress protein **REFERENCES** 1.Environmental Sciences by Santra 2.Environmental pollution by H. D. Kumar 3.Toxocology principles and Methods by M. A. Subramanyam 4.Toxicity of Pesticide of fish Vol. I & III, by A.S. Mourthy 5.Toxicology by Omkar 6.Water polltuon and Fish Physiology by Smith 7.Molecular Toxicology by Woods & Nelson	
PH8704D	**Paper III: Endocrinology, Reproduction and Development** Unit I : Chemical messengers Coordination of body functions by chemical messengers Hormones and their receptors Signal transduction pathway and it's regulation The hypothalamo- hypophysial-gonadal axes Unit II: Hormones and reproduction Testis : anatomy and physiology of male sexual organs, spermatogenesis and it's regulation; male accessory reproductive structures. Ovary: oogenesis, ovarian follicular growth and vitellogenesis; female accessory	**PH8704D Endocrinology, Reproduction and Development** Unit I : Chemical messengers Coordination of body functions by chemical messengers Hormones and their receptors Signal transduction pathway and it's regulation The hypothalamo- hypophysial- gonadal axes Unit II: Hormones and reproduction Testis : anatomy and physiology of male sexual organs, spermatogenesis and it's regulation; male accessory reproductive structures. Ovary: oogenesis, ovarian follicular growth and vitellogenesis; female accessory reproductive structures. Unit III: Impact of environmental chemicals on reproduction Endocrine disruptive chemicals Reproductive and neuroendocrine targets of EDCs Unit IV: Sex determination and differentiation in amniotes Sex determination - chromosomal sex determination, environmental sex determination Factors involved and controlling the sex determination Unit V: Hormones and development Hormonal regulation of sexual differentiation and development

	reproductive structures. Unit III: Impact of environmental chemicals on reproduction Endocrine disruptive chemicals Reproductive and neuroendocrine targets of EDCs Unit IV: Sex determination and differentiation in amniotes Sex determination - chromosomal sex determination, environmental sex determination Factors involved and controlling the sex determination Unit V: Hormones and development Hormonal regulation of sexual differentiation and development Preimplantation embryo development: cleavage, compaction, axes formation, blastocyst development, differentiation and implantation in mammals Endocrine, cellular and molecular regulation of early mammalian development: Role of Wnt signalling. Neuroendocrine regulation of development Unit VI: Anabolic- Androgenic Steroids (AAS) Impact of abuse of as compounds- biochemical and pharmacological impact Anabolic- Androgenic Steroids and immune function Anabolic- Androgenic Steroids and endocrine system	Preimplantation embryo development: cleavage, compaction, axes formation, blastocyst development, differentiation and implantation in mammals Endocrine, cellular and molecular regulation of early mammalian development: Role of Wnt signalling. Neuroendocrine regulation of development Unit VI: Anabolic- Androgenic Steroids (AAS) Impact of abuse of as compounds- biochemical and pharmacological impact Anabolic- Androgenic Steroids and immune function Anabolic- Androgenic Steroids and endocrine system
PH8704E Endocrinology & Development	**Paper-III-Endocrinology & Development** Unit I: Chemical messengers Co-ordination of body functions by chemical messengers Hormones and their Receptors Signal transduction pathway and its regulation The hypothalamo -adenohypophysial -gonadal axes Unit II: Hormones and reproduction Testis: Anatomy and physiology of male sexual organs, spermatogenesis and its regulation; male accessory	**PH8704E Endocrinology & Development** Unit I: Chemical messengers Co-ordination of body functions by chemical messengers Hormones and their Receptors Signal transduction pathway and its regulation The hypothalamo -adenohypophysial -gonadal axes Unit II: Hormones and reproduction Testis: Anatomy and physiology of male sexual organs, spermatogenesis and its regulation; male accessory reproductive structures. Ovary: Oogenesis, ovarian follicular growth and vitellogenesis; female accessory reproductive structure Unit III: Impact of Environmental chemicals on reproduction Endocrine disruptive chemicals Reproductive and Neuroendocrine targets of EDCs

	reproductive structures. Ovary: Oogenesis, ovarian follicular growth and vitellogenesis; female accessory reproductive structure Unit III: Impact of Environmental chemicals on reproduction Endocrine disruptive chemicals Reproductive and Neuroendocrine targets of EDCs Unit IV: Sex Determination and differentiation in amniotes Sex Determination- Chromosomal sex determination, Environmental sex determination Factors involved and controlling the sex determination Unit V: Hormones and development Hormonal regulation of sexual differentiation and development Neroendocrine regulation of development Unit VI: Anabolic -Androgenic steroids (AAS) Impact of abuse of AAS compounds Anabolic -Androgenic steroids and immune function Anabolic -Androgenic steroids and endocrine system REFERENCES Endocrinology: DeGroot, L.J., and Neill, J.D. (Ed.) IV Edition. Vol. I-III. W.B. Saunders Company, 2001 Endocrinology: Hadley, Mc.E. and Jon E. Levine(Ed.) VI Edition Prentice Hall Inc, 2007 Developmental Biology (IX Edition): Scott F. Gilbert (Ed.), Sinauer Associates Inc. USA, 2010 Principles of Development (II Edition): Lewis Wolpert, Oxford Univ. Press, New York, 2002	Unit IV: Sex Determination and differentiation in amniotes Sex Determination- Chromosomal sex determination, Environmental sex determination Factors involved and controlling the sex determination Unit V: Hormones and development Hormonal regulation of sexual differentiation and development Neroendocrine regulation of development Unit VI: Anabolic -Androgenic steroids (AAS) Impact of abuse of AAS compounds Anabolic -Androgenic steroids and immune function Anabolic -Androgenic steroids and endocrine system REFERENCES Endocrinology: DeGroot, L.J., and Neill, J.D. (Ed.) IV Edition. Vol. I-III. W.B. Saunders Company, 2001 Endocrinology: Hadley, Mc.E. and Jon E. Levine(Ed.) VI Edition Prentice Hall Inc, 2007 Developmental Biology (IX Edition): Scott F. Gilbert (Ed.), Sinauer Associates Inc. USA, 2010 Principles of Development (II Edition): Lewis Wolpert, Oxford Univ. Press, New York, 2002

PH8704F Limnology (Specialization)	**Paper – III : Limnology (Specialization)** Unit – I: Introduction and Definition, Types of Lakes, Classification and Structure Unit – II :Physical Limnology: Light, Heat and Water Stratification, Water movements Unit – III:Chemical Limnology: Photosynthesis, Dissolved oxygen, Carbon, pH, Alkalinity and Nutrients. Unit – IV :Biological Limnology: Primary production – phytoplankton, Secondary production-Zooplankton, Fish and Fisheries. Unit – V :Pollution in Lakes : Sedimentation, Eutrophication, Climate change Unit – VI :Wetlands: States, Conservation and Management. Reference : 1.'Ecology : Concepts and environmental applications in Limnology' by Walter K. Dodds & Matt. R. Whiles, Academic Press. 2.'Fresh Water Ecology' by Barbara Downes & Andrew Boulton, Blackwell Science 3.'The Biology of Lakes and Ponds' by Christen Bronmark and Lars 4.Anders Hanson, Oxford University Press. 5.'Aquatic Ecosystem' by Stuart Fintlay, Academic Press. 6.'Fundamentals of Limnology' by Arvind Kumar. APH Publishing Corporation 7.'Limnology Research in India by S.R. Mishra, Daya Publishing House. 8.'Limnology : Lake and River Ecosystem by Robert Wetzel, Academic Press, IIIrd Edition	PH8704F Limnology (Specialization) Unit – I: Introduction and Definition, Types of Lakes, Classification and Structure Unit – II :Physical Limnology: Light, Heat and Water Stratification, Water movements Unit – III:Chemical Limnology: Photosynthesis, Dissolved oxygen, Carbon, pH, Alkalinity and Nutrients. Unit – IV :Biological Limnology: Primary production – phytoplankton, Secondary production-Zooplankton, Fish and Fisheries. Unit – V :Pollution in Lakes : Sedimentation, Eutrophication, Climate change Unit – VI :Wetlands: States, Conservation and Management. Reference : 1.'Ecology : Concepts and environmental applications in Limnology' by Walter K. Dodds & Matt. R. Whiles, Academic Press. 2.'Fresh Water Ecology' by Barbara Downes & Andrew Boulton, Blackwell Science 3.'The Biology of Lakes and Ponds' by Christen Bronmark and Lars 4.Anders Hanson, Oxford University Press. 5.'Aquatic Ecosystem' by Stuart Fintlay, Academic Press. 6.'Fundamentals of Limnology' by Arvind Kumar. APH Publishing Corporation 7.'Limnology Research in India by S.R. Mishra, Daya Publishing House. 8.'Limnology : Lake and River Ecosystem by Robert Wetzel, Academic Press, IIIrd Edition
PH8704G Neuroendocrinology of Reproduction in Fish	**Paper – III : Neuroendocrinology of Reproduction in fish** 1.Structure of the fish ovary-	**PH8704G Neuroendocrinology of Reproduction in Fish** 1.Structure of the fish ovary-cellular sites of streroidogenesis. Dynamic events during the oocyte development-folliculogenesis

	cellular sites of streroidogenesis. Dynamic events during the oocyte development-folliculogenesis and vitellogenesis. 2.Hormonal regulation of oocyte maturation, ovulation and follicular atresia in teleost fish 3.Patterns of ovarian cycles in fishes. Recent advances in the hormonal regulation of ovarian cycles. Environmental control of reproduction. 4.General organization of hypothalamus and pituitary in teleosts. Comparative account of pituitary structure in different fish groups-cyclostomes, bony fish, teleost, elasmobranch and dipnoi fish. 5.Regulation of Gonadotropic hormone (GtH) release-elements in GnRH signal transduction, dopaminergic inhibition and steroid feedback. 6.Hypothalamo-pituitary-interrenal(HPI) axis – physiological response to stress. Relationship between glucocorticoids and metabolic consequences. 7.Endocrine effects of stress on sex steroids and gamete quality-recent advances. 8.Opioidergic mediation of stress-implications on reproduction. **REFERENCES** Bernier NJ , Van Der Kraak G, Farrell AP, Brauner CJ (2009) Fish Physiology: Fish Neuroendocrinology, *Academic press publications, London,* vol. 28 Guraya SS (1986) The Cell and Molecular Biology of Fish Oogenesis. Basel; *New York, Karger* (Monographs in developmental biology, vol. 18)	and vitellogenesis. 2.Hormonal regulation of oocyte maturation, ovulation and follicular atresia in teleost fish 3.Patterns of ovarian cycles in fishes. Recent advances in the hormonal regulation of ovarian cycles. Environmental control of reproduction. 4.General organization of hypothalamus and pituitary in teleosts. Comparative account of pituitary structure in different fish groups-cyclostomes, bony fish, teleost, elasmobranch and dipnoi fish. 5.Regulation of Gonadotropic hormone (GtH) release-elements in GnRH signal transduction, dopaminergic inhibition and steroid feedback. 6.Hypothalamo-pituitary-interrenal(HPI) axis – physiological response to stress. Relationship between glucocorticoids and metabolic consequences. 7.Endocrine effects of stress on sex steroids and gamete quality-recent advances. 8.Opioidergic mediation of stress-implications on reproduction. **REFERENCES** Bernier NJ , Van Der Kraak G, Farrell AP, Brauner CJ (2009) Fish Physiology: Fish Neuroendocrinology, *Academic press publications, London,* vol. 28 Guraya SS (1986) The Cell and Molecular Biology of Fish Oogenesis. Basel; *New York, Karger* (Monographs in developmental biology, vol. 18) Marshall FHA (1984) Marshall's Physiology of Reproduction: Reproductive cycles of vertebrates Churchill Livingstone. Olivereau M, Olivereau JM (1999) Prolactin, ACTH and Growth Hormone Secreting Cells in the Teleost Pituitary Gland: Environmental and hypothalamic control (K.P.Joy, A.Krishna, C.Haldar, Eds) *Narosa publishing house, New Delhi, India,* pp.69-92, Pankhurst NW, Van Der Kraak G (1997) Effects of stress on reproduction and growth of fish. In: Iwama GK, Pickering AD, Sumpter JP, Schreck CB (eds) Fish stress and health in *Aquaculture*. Cambridge University Press, Cambridge, pp 73–93 Subhedar NK, Khan FA, Saha SG, Burade VS, Sarkar S (1999) The hypothalamus of teleosts (K.P.Joy, A.Krishna, C.Haldar, Eds) *Narosa publishing house, New Delhi, India*, pp.54-68. Zohar Y , Muñoz-Cueto JA , Elizur A , Kah O (2010) Neuroendocrinology of reproduction in teleost fish. *General and Comparative Endocrinology* 165; 438–455.

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PH8704H Reproductive Endocrinology and Development of Teleosts	**Paper- III : Reproductive Endocrinology and Development of Teleosts** I. Reproductive Biology of Teleost fish – Female Structure of the Ovary-Cellular sites of steroidogenesis. Dynamic events during the Oocyte development – Folliculogenesis and vitellogenesis Hormonal regulation of Oocyte maturation, Ovulation and follicular atresia Patterns of Ovarian cycles – Recent advances in the hormonal regulation of Ovarian cycles.	**PH8704H Reproductive Endocrinology and Development of Teleosts** I. Reproductive Biology of Teleost fish – Female Structure of the Ovary-Cellular sites of steroidogenesis. Dynamic events during the Oocyte development – Folliculogenesis and vitellogenesis Hormonal regulation of Oocyte maturation, Ovulation and follicular atresia Patterns of Ovarian cycles – Recent advances in the hormonal regulation of Ovarian cycles. II. Reproductive Biology of Teleost fish – Male Structure of the testis – cellular sites of steroidogenesis Spermatogenesis – Seasonal and continuous breeding teleosts Hormonal regulation of spermatogenesis Recent advances in the hormonal regulation of testicular cycles

	II. Reproductive Biology of Teleost fish – Male Structure of the testis – cellular sites of steroidogenesis Spermatogenesis – Seasonal and continuous breeding teleosts Hormonal regulation of spermatogenesis Recent advances in the hormonal regulation of testicular cycles III. Developmental studies in fish Development of different endocrine glands in teleosts Gonadal differentiation-primordial germ cells, structure, migration and quantitative estimation Ovarian development-Oogenesis, Folliculogenesis and Follicular kinetics Testicular development-Differentiation, Growth, Celluar components and spermatogenesis. Sex-Differentiation, effect of sex hormones and sex reversal in teleosts IV. Endocrine Regulation of Fish reproduction Hormones and endocrine system in Teleosts General organization of Pineal, Hypothalamus, Pituitary and Interrenal in teleosts V. Environment & reproduction in Fish Environmental control of Reproduction Effect of pollutants/Chemicals on physiology of Teleosts	III. Developmental studies in fish Development of different endocrine glands in teleosts Gonadal differentiation-primordial germ cells, structure, migration and quantitative estimation Ovarian development-Oogenesis, Folliculogenesis and Follicular kinetics Testicular development-Differentiation, Growth, Celluar components and spermatogenesis. Sex-Differentiation, effect of sex hormones and sex reversal in teleosts IV. Endocrine Regulation of Fish reproduction Hormones and endocrine system in Teleosts General organization of Pineal, Hypothalamus, Pituitary and Interrenal in teleosts V. Environment & reproduction in Fish Environmental control of Reproduction Effect of pollutants/Chemicals on physiology of Teleosts
PH8704I Vermitechnology	V **Paper – III : Vermitechnology (Specialization)** **PH8704I Vermitechnology** Unit – I: Introduction : Earthworm Taxonomy, Status of Earthworms	**PH8704I Vermitechnology** Unit – I: Introduction : Earthworm Taxonomy, Status of Earthworms Diversity; Developments in Vermitechnology in India and World. Unit – II : Earthworms : Morphology, Anatomy, Biology and Ecology

	Diversity; Developments in Vermitechnology in India and World. Unit – II : Earthworms : Morphology, Anatomy, Biology and Ecology Unit – III:Influence of Earthworms on physical & chemical properties of soil, soil fertility amd Micro organisms Unit – IV :Types of Earthworms, Organic Waste Management and recycling of plants nutrients. Unit – V :Vermiculture and Vermicomposting : Methods of Production of Vermicompost, Worm biomass and Vermiwash : Chemical composition and its uses Unit – VI :Application of vermitechnology Reference : 1.'Earthworms : Their Ecology and Relationship with Soils and Land Use'. Academic Press, New York, Lee K.E. (1985). 2.'Earthworm Ecology' ORC press, Florida, Edwards C.A. (1998) 3.'Verms and Vermitechnology'. A.P.H Publishing Corporation, New Delhi, Prof. Arvind Kumar (2005) 4.'Vermicomposting for sustainable Agriculture'. Agrobios (India), Jodhpur, Dr. P.K. Gupta (2003) 5.'Vermiculture and Organic farming'. Daya Publishing House, Delhi, Prof. T.V. Sathe(2004) 6.'The role of earthworms in	Unit – III:Influence of Earthworms on physical & chemical properties of soil, soil fertility amd Micro organisms Unit – IV :Types of Earthworms, Organic Waste Management and recycling of plants nutrients. Unit – V :Vermiculture and Vermicomposting : Methods of Production of Vermicompost, Worm biomass and Vermiwash : Chemical composition and its uses Unit – VI :Application of vermitechnology Reference : 1.'Earthworms : Their Ecology and Relationship with Soils and Land Use'. Academic Press, New York, Lee K.E. (1985). 2.'Earthworm Ecology' ORC press, Florida, Edwards C.A. (1998) 3.'Verms and Vermitechnology'. A.P.H Publishing Corporation, New Delhi, Prof. Arvind Kumar (2005) 4.'Vermicomposting for sustainable Agriculture'. Agrobios (India), Jodhpur, Dr. P.K. Gupta (2003) 5.'Vermiculture and Organic farming'. Daya Publishing House, Delhi, Prof. T.V. Sathe(2004) 6.'The role of earthworms in waste disposal and protein production'. Rothamslted Expt. Stn. Engaland, C.A. Edwards (1981) 7.'Biology of earthworms'. Chapmann and Hall, London, Edward C.A. and Lofty J.R. (1977) 8.'Earthworms in Soil Fertility: Earthworm Cinderella of Organic Farming', Prism books Pvt. Ltd., Bangalore (India), Kale R.D. (1998) 9.'Vermicology: The Biology of Earthworms'. Ismail S.A. (1997)

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* Modifications should be highlighted in YELLOW colour

The relevant **copy of the BOS proceedings approving the revision/modification have to be sen**t.

At the end, the **Chairman, BOS has to prepare the following certificate**, sign it, scan it and send it to the IQAC, **separately.**

CERTIFICATE

This is to certify that the curriculum of M.A./M.Com./M.Sc. (retain whichever is applicable) in _____ has been revised during ____ (mention year) and _____ % of content was replaced/added/modified.

Chairman, BOS

CERTIFICATE

This is to certify that the curriculum of M.Phil/Ph.D. (retain whichever is applicable) in _____ has been revised during ____ (mention year) and _____ % of content was replaced/added/modified.

Chairman, BOS

C. Format for Indicating the Regional, State, National and Global relevance of the Outcomes in the current curriculum

Programme Code and Name
Courses having **Regional** Relevance
1. Course code and Name
2. Course code and Name
Courses having **State** level Relevance

1. Course code and Name
2. Course code and Name
Courses having **National** level Relevance
1. Course code and Name
2. Course code and Name
Courses having **Global** level Relevance- All courses are of international relevance
1. Course code and Name
2. Course code and Name

If a given course comes under multiple/all categories, it may be mentioned so.

D. Format for Indicating Employability*/Entrepreneurship/ Skill Development*** Aspects in the curriculum (to be prepared for all previous five years – 2016-17 to 2020-21, for whatever curriculum was/is in force)**

Employability/Entrepreneurship/Skill Development Aspects of the Courses	**One line description**
All practicals are related to Skill Development	
PG87T403- Applied Zoology has Entrepreneurship Relavance	
2016-17	
1. Course code and Name	
2. Course code and Name	
2017-18	
1. Course code and Name	
2. Course code and Name	
2018-19	
1. Course code and Name	
2. Course code and Name	
2019-20	
1. Course code and Name	
2. Course code and Name	
2020-21	
1. Course code and Name	
2. Course code and Name	

* Employabilityaspects should be highlighted in LIGHT GREEN colour
**Entrepreneurshipaspects should be highlighted in LIGHT BLUE colour
***Skill Development aspects should be highlighted in LIGHT PURPLE colour

E. Format for theList and description of the courses which address the **Gender, Environment and Sustainability, Human Values and Professional Ethics** in the current curriculum

Course code and Name	Indicate whether the course addresses **Gender, Environment and Sustainability, Human Values or Professional Ethics**
1.	Gender issues
2. PG87T104	Environment and Sustainability- Environmental Biology
3.	Human Values
4.	Professional Ethics

F. Format for information **on students undertaking internships/Field Projects/Research projects** (for the latest batch of students)

List of students undertaking internships			
Program Code	Programme name	Name of students undertaking internships	e-copy of certificates to be provided

List of students undertaking field projects /Research Projects **Please see the information submitting on 04-02-2022 at 5.16pm**			
Program Code	Programme name	Name of students undertaking field/research projects	e-copy of certificates to be provided

G. Links for Feed backs on curricula (WILL BE SHARED WITH YOU IN DUE COURSE)

2016-17	To be circulated among teachers and students on roll during the year
Teachers	
Students	
2017-18	
Teachers	
Students	
2018-19	
Teachers	
Students	

Sir/Madam,

Please find herewith attached formats for your perusal and compliance:

1. Criterion I – Curricular Aspects.
2. Criterion II – Teaching, Learning and Evaluation
3. Criterion III – Research, Innovation and Extension
4. Criterion IV – Infrastructure and Learning Resources
5. Criterion V – Student Support and Progression
6. Criterion VI – Governance, Leadership and Management
7. Copy of the presentation made in the meeting

You are requested to send the information in the format given, preferably in **MS-Excel** and mail it to directoriqac@kud.ac.in by **February 11, 2022 positively.**

Tel: UNIKARNATAK ☎ : 0836 – 2215230
Fax: 0836 – 721275
KARNATAK UNIVERSITY
DHARWAD – 580003, Karnataka (India)
DEPARTMENT OF ZOOLOGY

No. KU/PG/ZOO/2021-22/ Date: 17-02-2022

CERTIFICATE

This is to certify that the curriculum of M.Sc. in Zoology has been revised during 2019-20 and 10 % of content was replaced/added/modified.

Sd/-
Chairman, BOS

CERTIFICATE

This is to certify that the curriculum of Ph.D. in Zoology has been revised during 2019-20 and 10 % of content was replaced/added/modified.

Sd/-
Chairman, BOS