Centre for Multidisciplinary Research
TEZPUR UNIVERSITY
Syllabus for PhD Coursework

Preamble

1. The Centre for Multidisciplinary Research will promote research in specialised areas of multidisciplinary nature only.
2. The CMDR will encourage research in multidisciplinary domains promoting synergy of indigenous knowledge systems and international/global scientific research traditions.
3. The course work for the doctoral programme in CMDR will be conducted by CMDR in collaboration with the supervisors attached enlisted with the centre.

Programme Outcome (PO's)

- PO1: Plan, propose and execute multidisciplinary research with social, and scientific relevance; and having local, regional, national and global implications
- PO2: Synthesize and integrate research traditions of multiple disciplines for problem solving and innovation
- PO3: Critically analyse socio-scientific issues for research problem formulation and develop appropriate multidisciplinary methodological framework for investigation
- PO4: Understand and appreciate the philosophical roots of social-scientific knowledge and life processes for human development

2. Programme structure

Course Category	No of Courses	Credits per course	Total Credits
Core Courses	02	04	08
Core Courses (Recommended by UGC)	01	02	02
Elective Courses	02	03	06
Open Elective Courses	--	--	--
Total Credits			16

3. List of Courses

Core Courses						
Course Code	**Course Title**	**L**	**T**	**P**	**CH**	**CR**
MR701	Research Methodology	1	3	0	4	4
MR702	Literature Review	0	4	0	4	4
RP 799	Research and Publication Ethics	2	0	0	2	2
Elective Courses						
MR703	Philosophy of Research	2	1	0	3	3
MR704	History of Science	2	1	0	3	3
MR705	Reductionist and Holistic Approaches to Life and Research	2	1	0	3	3

L: Lecture T: Tutorial P: Practical CH: Contact Hours CR: Credit

4. Mapping of course with programme outcome (PO's)

Course Code	**Course Title**	**PO1**	**PO2**	**PO3**	**PO4**
MR701	Research Methodology	√		√	
MR702	Literature Review				√
MR703	Philosophy of Research		√	√	
MR704	History of Science	√			√
MR705	Reductionist and Holistic Approaches to Life and Research	√	√		

DETAILED SYLLABUS

Research Methodology MR 701
L-T-P:3-0-1 Credits:4 Contact Hours:4

Course Outcomes

- CO1: Appreciate and contextualize the need, role, importance, function and ethics of research from multidisciplinary perspective
- CO2: Use, apply and execute appropriate research methods to carry out multidisciplinary research
- CO3: Apply the skills of data gathering, analysis, computation and presentation in research

Course Content

Unit-I

- Meaning of Science and Scientific research
- Scope and relevance of research for society
- Steps in scientific research
- Formulation of research problems
- Multidisciplinary approaches in research

Unit-II

- Research design: features and types
- Methodology and methods of research
- Role of theory in research
- Research questions and hypothesis building

Unit-III

- Types and sources of data
- Tools and techniques of data collection
- Variables and samples

Unit-IV

- Data analysis and thesis report writing
- Use of statistics in data interpretation
- Data analysis software
- Organization of thesis
- Referencing and citation

Deliverables

1. Formulation of research problems including background and problem statement (1500 words)
2. Developing a tentative methodological framework (1000 words)
3. Presentation on (1) and (2) above

Text Books

1. Research Methodology: Methods and Techniques. C.R.Kothari and Gaurav Garg New Age international publishers. Fourth edition 2019
2. Fundamentals of Mathematical Statistics. S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi. 1999.

References Books

1. Research Methodology, Mukul Gupta, Deepa Gupta PHI Learning Private Ltd. New Delhi.2011
2. A Hand Book of Methodology of Research Rajammall, P.Devadass and K.Kulandaivel RMM Vidyalaya press. 1976.
3. Statistical Methods. G.W. Snedecor and W.G. Cochrans. Lowa state University Press. 1967. PA
4. Thesis and Assignment Writing, J.Anderson, Siley Eastern Ltd. 1997.

Literature Review MR 702
L-T-P:0-4-0 Credits:4 Contact Hours:4

Course Outcomes

- CO1: Identify multidisciplinary literature relevant for a proposed research problem
- CO2: Analyse and establish connections between theoretical premises and methodological formulations in multidisciplinary research
- CO3: Correlate and connect available knowledge and literature of multiple disciplines to arrive at comprehensive review relevant for an identified research problem

Course Content

- As part of this paper student will first identify literature relevant to the specific area of research chosen by him/her. The literature will have to be identified keeping in mind the different domains integrating into his/her multidisciplinary research proposal.
- The candidate will undertake extensive desk review of such literature to develop contextual clarity with regard to the specific problem identified for his/her research work.
- The list of literature to be reviewed will be developed in consultation with the supervisors

Deliverables

1. Writing a term paper outlining all the literature reviewed while establishing their interrelationship and relevance for the proposed problem identified by the scholar.
2. Giving a presentation at the centre office explaining and defending the reviewed literature.

Philosophy of Research MR 703
L-T-P:3-0-0 Credits:3 Contact Hours:3

Course outcomes

- CO1: Ability to understand the philosophical roots of scientific knowledge and resercah
- CO2: Ability to grasp the significant epistemic discourses both in Indian and Western contexts
- CO3: Ability to apply philosophy in own area of research

Course Content

Unit-I

- Philosophical Foundation of Research
- Source of Knowledge: Nyâya and Lokayatta
- Buddhist approach to understand reality Empiricism and Rationalism (Bacon and Descartes)

Unit-II

- Subjectivity and Objectivity
- Max Weber: Verstehen, Value Judgement Donna Harway: Situated Knowledge
- Sandra Harding: Science from Below

Unit-III

- Nature of Science Debate
- Karl Popper: Falsification
- Thomas Kuhn: Paradigm Shift
- Imre Lakatos: The 'science' of pseudoscience Paul Feyerabend: Against Method
- J. D. Bernal: Character of Science

Deliverables

1. Term paper on a topic suggested by the course instructor
2. Presentation either on the topic of the term paper or on a separate topic

Text books

1. Kuhn, T. S. The Structure of Scientific Revolutions.University of Chicago Press. London. 1970
2. Surukhai, Sundar. Indian Philosophy and Philosophy of Science , PHISPC, Centre for Studies in Civilisations, New Delhi, 2005.

Reference books

1. Aron, R, Main Currents of Sociological Thought. 2.Vol. Penguin, London,1981
2. Feyerabend P. Against Method: Outline of an Anarchistic Theory of Knowledge. London: New Left Books, 1975.
3. Lakatos, I. and Alan Musgrave ed. Criticism and Growth of Knowledge. Cambridge: Cambridge University Press, 1970.
4. Malcolm, W. and T. May. Introduction to the Philosophy of Social Research. London: Routledge, 1996.
5. Popper, K, The Logic of Scientific Discovery. Routledge.London, 1999
6. Zeitlin, M, Ideology and the Development of Sociological Theory, Prentice Hall, New Jersey 1968
7. Harding, Sandra, Sciences From Below: Feminisms, Postcolonialities & Modernities, Duke University Press, Durham, 2008.

History of Science MR 704
L-T-P:3-0-0 Credits:3 Contact Hours:3

Course outcome

CO1: Appreciate Indian tradition and knowledge system.

CO2: Realize contribution made by different scientists.

CO3: Connect social need to scientific innovations.

Course Content

Unit I: Biology:

Biology and human civilization: Evolution of life on Earth; Human migration; Domestication; Agriculture; Bioresources in travel and trade; Medical practices; Columbian Exchange.
Secret of life: Pathways leading to discovery of chemical nature and structure of genetic material; Discovery of information flow in biology.
Mathematics in biology: Biological events using mathematics.
Beginning of modern Biology: Cell Theory; Darwins theory of evolution; Mendel's theory of inheritance; Synthetic theory of evolution; Pasteur's Germ Theory; Emergence of new disciplines, Life in Plant
Biology in medicine and society: Biology in human health, Changing face of science, scientist, science communication, institutions devoted to biology research, commercial value, evolving technology involved, knowledge management, future trends.

Unit II: Chemistry:

Old traditions of chemical sciences in various countries; Ancient technology; Medicine in the ancient times; Ayurvedic chemistry.

Alchemy - India, Islamic and Chinese alchemy; Metal extraction in the ancient times; Fiber, cloth and dying chemistry in the ancient times, Paper and ink in ancient times.

Modern traditions and methods; Chemical revolution - from Boyle to Dalton; Priestley's discovery of dephlogisticated air; Lavoisier and oxygen.

Construction materials in the ancient times; Iron pillar of Delhi; Science and technology in the West; Medieval and renaissance medicine;

Discoveries and inventions in the context of state of art and impact; Development of chemistry during the industrial revolution; Development of chemistry during world war, Ethics in science.

Unit-III: Mathematics

Early Number Systems and symbols, Mathematics in early civilizations - Egypt, Mesopotamia, Greece; Mathematics in ancient India and China; Islamic mathematics; Mathematics in medieval Europe.

Mathematics in 18^{th} and 19^{th} century; Contributions of Euler, Gauss, Riemann, Jacobi, Abel, Galois and other notable mathematicians.

Algebra, trigonometry and arithmetic in the renaissance; Analytic geometry in the seventeenth century - Descartes and Fermat; Newton and Leibniz, and the calculus. Indian mathematical genius Srinivasa Ramanujan; Advent and development of computers and their uses in scientific computations.

Unit: IV Physics:

Early history and scientific revolutions: Science, philosophy of sciences, physics; Ancient civilizations - Greek, India, China and Arab; Medieval years; Scientific revolution - Copernicus, Galileo, Kepler, Descartes, Newton.

Birth of modern physics: Mechanics and its developments; Thermodynamics and its developments; Electricity and magnetism - early development and Maxwell; Development of quantum mechanics - Planck, Schrodinger, Dirac, Heisenberg; Relativity and Einstein, S.N. Bose.

Contemporary Physics: Standard model of particle physics - discoveries of particles, quark-parton model, field theories; Beyond standard model - string theory, super symmetry; Compilation of data of large no. of stars and comets; General theory of relativity and large scale structure; Evolution of stars - white dwarfs, red giants, neutron stars, black holes, pulsars, quasars; Expansion of the universe; CMBR; Hubble space telescope; Space explorations.

Deliverables

1. Term paper on a topic suggested by the course instructor

2. Presentation either on the topic of the term paper or on a separate topic

Text books:

1. Einsten A. and Infeld, L., The Evolution of Physics, (The Scientific Book Club, 1999).
2. Simony Karoly, A Cultural History of Physics, (CRC Press, Taylor and Francis, 2008).
3. Bernard C.I., The Birth of a New Physics, (W. W. Norton and Company, 2011).
4. Ernst Mayr, The Growth of Biological Thought: Diversity, Evolution, and Inheritance.
5. Loxton, D. Evolution: how we and all living things came to be.
6. Brock, W. H. The Chemical Tree: A History of Chemistry, W. W. Norton & Co.: New York, 2000.
7. Bell, M. S. Lavoisier in the Year One, W. W. Norton & Co.: New York, 2005.
8. Victor Katz, A History of Mathematics, 3rd Edition, Pearson Addison-Wesley: Boston, MA, 2009.
9. David Burton, The History of Mathematics: An Introduction, 6th Edition, McGraw-Hill, 2007.

References Books:

1. Carl B. Boyer, A History of Mathematics, 2nd Ed., Wiley, NY, 1991.
2. Dirk J. Struik, A Concise History of Mathematics, Dover Publications, New York, 1967.
3. Florian A. Cajori, A History of Mathematics, 5th Ed., Chelsea, New York, 1991.
4. Nicolas Bourbaki, Elements of the History of Mathematics, Springer-Verlag, New York, 1993.
5. Morris Kline, Mathematical Thought from Ancient to Modern Times, Oxford University Press, New York, 1972.
6. Eric T. Bell, Men of Mathematics, Touchstone Book, 1986.
7. Great books of the western world, edited, (Encyclopedia Britanica Publications, 2010).
8. Agar, Jon, Science in the twentieth century and beyond, (Cambridge: polity press, 2012).
9. Ben-Claim, Michael, Experimental philosophy and the birth of empirical science, (Aldershot: Ashgate, 2004).
10. Dear, Peter, The mathematical way in the scientific revolution, (university of Chicago press,1995).

11. Drak, Stillman, Galileo at Work: His scientific biography, (University of Chicago press, 1978).
12. Heilbron, J.L., Electricity in the 17^{th} and the 18^{th} centuries, (University of California press,1979).
13. Jhiele, Pudiger, Arabic Sciences and Philosophy, (Cambridge University press, 2005).
14. Schweber, Silvan, QED the man who made it, (Princeton University press, 1994).
15. Kragh, Helge, Quantum Generations: A history of physics in the twentieth century, (Princeton University press,1999).

Reductionist and holistic approaches to life and research MR 705
L-T-P:3-0-0 Credits:3 Contact Hours:3

Course outcome

CO1: Ability to understand the difference between living and non-living.
CO2: Ability to appreciate the differences among living organisms such as plants, animals and human
CO3: Ability to understand Human unique feature of learning perspective of biochemical reactions

Course content

Unit I:

What is life: how molecules get life? Every cell/body is C,H,N,S,O… then, when how do we call something has life? What is the principle behind the Life? Introduction to reductionist and holistic view and its significance.

Unit II:

Introduction to different biological systems (life forms): (i). a) Microorganism; b) Plants; c) Animals; d) Humans. (ii). Holistic and reductionist differences among the living forms.

Unit III:

Reductionist view in biology : a) Theories of evolution by Lamarck and Darwin, b) Theory of germ-plasm by Wiesmann, c) Principles of Inheritance by Mendel, d) Molecular and cellular biology: i) Biochemistry; ii) Molecular Biology; iii) Cell biology; iv) Genetic Engineering, iv) Cloning organism; v) Genome editing; vi. Omics

Unit IV:

Holistic view of life: i)Nature vs Nurture ii) Tradition and health iii)Indian knowledge system

Unit V:

Logic and emotion in human: The biology of belief, what is thought" or "What is consciousness", plastic brain, metacognition, theory of mind, artificial intelligence, creative intelligence

Deliverables

1. Term paper on a topic suggested by the course instructor
2. Presentation either on the topic of the term paper or on a separate topic

Text Books:

1) Lipton, B. H. (2016). The biology of belief: unleashing the power of consciousness, matter & miracles. 10th anniversary edition. Carlsbad, California: Hay House, Inc.
2) Hegde B. M. (2019) What Doctors Don'T Get To Study In Medical School Board
3) Gene an intimate History by Siddhartha Mukherjee

References Books:

1) Hegde, B.M. (1993). Holistic Living. Bharatiya Vidya Bhavan.
2) Hegde, B.M. (2004). You Can Be Healthy. Macmillan Publishers India Limited.
3) Graur, Dan, Amy K. Sater, and Tim F. Cooper. Molecular and Genome Evolution. 2016.
4) DNA the secret of life by J. D. Watson
5) Who will cry when you die by Arun Sharma
6) The Sapiens by Yuval Noah Harari
7) Genetics by Hartl and Jones
8) Molecular biology of the Gene by Watson et al.

Research and Publication Ethics RP 799
L-T-P:2-0-0 Credits:2 Contact Hours:2

Theory

RPE 01: PHILOSOPHY AND ETHICS

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

RPE 02: SCIENTIFIC CONDUCT

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

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

RPE 04: OPEN ACCESS PUBLISHING

1. Open access publications and initiatives
2. SHERPA/RoME0 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

A. Group Discussions

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

Use of plagiarism software like Turnitin, Urkund and other open source software tools

RPE 06: DATABASES AND RESEARCH METRICS

A. Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

B. Research Metrics

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

Bird, A. (2006). Philosophy of Science. Routledge.

Maclntyre, Alasdair (1967) A Short History of Ethics. London.

P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978- 9387480865

National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press.

Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental Health Sciences, 1-10. Retrieved from https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. https://doLorg/10.1038/489179a

Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019), ISBN:978-81-939482-1-7. ttp://www.insaindiases.in/pdf/EthicsBook.pdf