

Ph.D Course Work Syllabus

Dept. of Biotechnology,

Bodoland University

Distribution Pattern (60 + 20+20=100)

Final Exam (60 marks) + Seminar/ Unit Test (20 Marks) + Assignment (20 Marks)=100 marks

Name of the Papers	Paper code
Research Methodology & Biostatistics	1.01
Modern trends in Biotechnology	1.02
Information and Communication Technology, Bioinformatics and application	1.03
Optional Papers	1.04
Research and Publication ethics	1.05

Paper-1.01

Research Methodology and Biostatistics

Unit-1	Introduction to Research Methodology	Marks
	<p>i) Research:What is Research? Reflection, Science and Research , Basic and Applied Research, Essential steps in Research.</p> <p>ii) Literature Collection: Need for review of literature, Review process and bibliography, Research Reading, Discriminative Reading, Consulting Source Material, Working Bibliography, Index Card and Reference Card.</p> <p>iii) Literature Citation : Introduction, different system of Citing References</p> <p>iv) Research Methodology: An Introduction Meaning of Research, Objectives of Research, Motivation in Research ,Types of Research ,Research Approaches ,Significance of Research, Research Methods versus Methodology, Research and Scientific Method ,Importance of Knowing How Research is Done ,Research Process, Criteria of Good Research ,Problems Encountered by Researchers in India .</p> <p>v) Defining the Research Problem: Defining Research</p>	20

	Problem, Selecting the Problem ,Necessity of Defining the Problem ,Technique Involved in Defining a Problem ,An Illustration Conclusion .	
<p>Books:</p> <p>1) Research Methodology. Methods and Techniques. Second Revised Edition. By C.R. Kothari. New Age International Publication.</p> <p>2) Research Methodology for Biological Sciences. By N. Gurumani. MJP. Publishers.</p> <p>3)Scientific Thesis Writing and Paper Presentation. By N. Gurumani. MJP Publishers</p>		
UNIT II	Use of Statistical tools in Biological Research	20
	<p>i. Research Design/ Experimental Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Conclusion., Developing a Research Plan</p> <p>ii. Sampling Design Census and Sample Survey, Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of Sample Designs, How to Select a Random Sample? Random Sample from an Infinite Universe, Complex Random Sampling Designs, Conclusion.</p> <p>iii. Methods of Data Collection Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data.</p> <p>iv. Processing and Analysis of Data:Processing Operations, Some Problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), Measures of Relationship, Simple Regression Analysis, Multiple Correlation and Regression, Partial Correlation, Association in Case of Attributes, Other Measures.</p>	

	<p>v. Testing of Hypotheses-I (Parametric or Standard Tests of Hypotheses) What is a Hypothesis? Basic Concepts Concerning Testing of Hypotheses, Procedure for Hypothesis Testing, <i>Flow Diagram</i> for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses, Important Parametric Tests, Hypothesis Testing of Means, Hypothesis Testing for Differences between Means, Hypothesis Testing for Comparing Two Related Samples, Hypothesis Testing of Proportions, Hypothesis Testing for Difference between Proportions, Hypothesis Testing for Comparing a Variance to Some Hypothesized Population Variance, Testing the Equality of Variances of Two Normal Populations, Hypothesis Testing of Correlation Coefficients, Limitations of the Tests of Hypotheses.</p> <p>vi. Testing of Hypotheses-II (Nonparametric or Distribution-free Tests) Important Nonparametric or Distribution-free Test, Relationship between Spearman's r's and Kendall's W, Characteristics of Distribution-free or Non-parametric Tests, Conclusion.</p> <p>vii. Interpretation and Report Writing Meaning of Interpretation, Why Interpretation?, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.</p> <p>viii. Basics of Intellectual Property Right (IPR): Type of IPR, IPR in India., IP in Animal and Plant Science, IPR Regime and Technology Advancement. IPR in context to Genetic Resource for food and agriculture., Patentable and Non patentable invention, Drafting and prosecution of Patent application in India, Infringement of Patent and Relief. Commercialization of patents through technology transfer workshops., QTL and its application for genetic improvement in livestock in IPR Era, Traditional knowledge system and IPR, Biodiversity and</p>	
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	<p>Biopiracy</p> <p>ix. Essentials in Statistics: Classification of Data and Graphical Representation of Data, Test of Significance, Student's 't' test, Chi- Square test, Correlation and Regression, Binomial and Poisson Distribution, Normal Distribution, F-test, Z-test, Analysis of Variance., Probability.</p>	
<p>Books:</p> <ol style="list-style-type: none"> 1) Research Methodology. Methods and Techniques. Second Revised Edition. By C.R. Kothari. New Age International Publication. 2) Research Methodology for Biological Sciences. By N. Gurumani. MJP. Publishers 3) Methods in Biostatistics: For medical students and Research Workers. B.K.Mahajan. Jaypee Publishers. 4) Introduction to Biostatistics. Pranab Kumar Banerjee. S. Chand 5) Statistical Methods: By S.P Gupta. Educational Publishers New Delhi. 6) Basic Biostatistics. Suresh Kumar and Satya Veeri . Campus Books International Publishers. 		
UNIT III	Instrumentation and Biological Research	20
	<ol style="list-style-type: none"> 1) Laboratory Safety, Sterilization & Disinfection, Microscopy, Centrifugation, pH and pH meter, Chromatography, Electrophoresis, Colorimetry and Spectrophotometry, Photography, ELISA, RIA 2) Immunodiagnostic Methods, Radioisotopes, Methods of Environmental analysis like Molecular Luminescence Methods, Atomic Absorption Spectroscopy, Organ Ablation/ Surgical Techniques. 3) Preparation of reagents and different parameters associated with it like Normality, Molality, Molarity, Formality etc 4) Management of Laboratory Animals. 	
<p>Books:</p> <ol style="list-style-type: none"> 1) Research Methodology for Biological Sciences. By N. Gurumani. MJP. Publishers 2) Biotechniques. Theory & Practice. S.V.S. RANA. Rastogi Publication. 		

3) An Introduction to Electrophoresis. By K. Anbalagan 4) Basic Cell Culture: J.M. Davis	
ASSIGNMENT: a) Research Project Proposal Writing b) Presentation of Research Finding	20 20
UNIT TEST/ SEMINAR	
	100

Paper-1.02

Modern Trends in Biotechnology

Unit-1:	Environmental Biotechnology:	Marks
	Concept of Biodiversity, Biodiversity at local, national and global level. Values of Biodiversity, measurement of biodiversity, threats to biodiversity, man animal conflict, genetic resources in animal and plant sciences in national context, global biodiversity strategy and its significance for sustainable agriculture, useful genes and their prospects of utilization through biotechnology, Convention on biological diversity. Biotechnology, Biodiversity and IPR, <i>in-situ</i> and <i>ex-situ</i> conservation, gene bank, Ramsar sites, sustainable development, Environmental Impact Assessment. Radiation Biology (Crompton effect, Auger effect, radiation effect on subcellular system, loss of reproductive ability in cells, effect on cell cycle, Effect on repair and recovery, acute radiation damage, late somatic effect, radiation therapy). Water purification, Rehabilitation of Natural Water Bodies, Bioassay methods in context to assessment of water quality, Water and its properties with special reference to North East India., Cycling of Nutrients in water systems, Enhanced reproductive technologies in sericulture, Algal	20

	<p>Biomass estimation, Nygaard's Algal Indices, Palmer's Algal Pollution Indices, Species diversity indices, Sequential Comparison indices, waste water treatment plants, Biological Waste treatments, establishment of water monitoring laboratory. World Energy Resource – Consumption and Conservation. Cryopreservation, Bioprospecting, Production of Primary and Secondary Metabolites. Production of biofertilizers, biological control of pests, pathogen and weeds, Single Cell Protein, Biofuels, Microbial Enhancement of Oil Recovery (MEOR), Conversion of Wood mass, Bioremediation, biodegradation, Removals of metal from water, biomining.</p>	
<p>Books:</p> <ol style="list-style-type: none"> 1) Biological Radiation Effects: By Jurgen Kiefer . 2) Biodiversity. By K.C. Agarwal. Agro Botanica 3) Potential and Existing Ramsar Sites in India. By M. Zafar-Ul-Islam and Asad R. Rahmani. 4) Chemical and Biological Methods for water pollution studies. By R.K.Trivedy & P.K.Goel. 5) Environmental Chemistry. By Anil Kumar De. New Age International Publication. 6) Biotechnology. By V. Kumaresan. Saras Publication 		
Unit-II:	Genetic Engineering and Molecular Biology	
	<p>Enzyme technology, Cloning system, production of transgenic plant for fungal, bacterial and viral disease resistance, drought and other abiotic stress resistance; quality parameters, nutraceuticals, edible vaccines , application of gene pyramiding and RNAi technology. Microbial production of enzymes, regulation of enzyme biosynthesis, extraction of enzymes. Gene cloning vectors, construction of recombinant DNA, transfer of recombinant DNA to competent cells, expression of cloned genes, Genetically Engineered Microorganisms(GEMOs), Operon Concept, Risk of Releasing Genetically engineered Organisms, DNA finger printing and DNA Foot Printing, Germplasm Storage.</p>	

	Plasmid, IS Element, Transposons and Retroelements, multigene families, phenotypic expression of gene, post translational modification of protein, Regulation of gene action in Bacteria and Viruses, Regulation of gene action in Eukaryotes	
Books: 1) Biotechnology. By V. Kumaresan. Saras Publication. 2) Molecular Biology. By P.S Verma and V.K Agarwal. S. Chand Publication		
Unit-III:	Microbiology, Probiotics and Food Biotechnology	
	History and Scope of Microbiology, microbial nutrition, growth and control, microbial metabolism, viruses, non specific resistance and the immune response, microbial disease and their control, fermentation microbiology. Probiotics, prebiotics and functional foods, WHO guidelines for probiotics and functional foods, bioactive peptides, safety of probiotics Nutragenomics. Cereal Technology, Post harvest loss of cereal grains, processing of cereals. Legume Technology, decortications, germination, fermentation, agglomeration, toxic factors in legume. Oil Seed Technology, Extraction of oil, special treatment for edible oil, Harvesting, caring and shelling, processed product Fruit and vegetable technology, Ripening of fruits, control of post harvest diseases, commercial storage operation, prepackaging operations, processing and preservation, Dairy Technology, Flesh Food Technology, Food additives, Extruded Foods, Food Irradiation, Packaging Technology.	
Books: 1) Food Processing and Preservation. By G. Subbulakshmi, Shoba A Udipi, New Age International Publication 2) Prescott, Harley and Klein's Microbiology. By Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton		
ASSIGNMENT Hands on technique/ sensitization of applied Biotechnology/ Bamboo Technology/Fermentation Technology		20

UNIT & SEMINAR		20
		100

Paper-1.03

Information and Communication Technology, Bioinformatics and their application.

UNIT-1	Information and Communication Technology	Marks
	Basic Concepts, Using the Computer and Managing Files, Word Processing, Databases, Graphics (Paint and Presentation), Information and Communication, Patents and ICT, Desktop Publishing, Data and its existence in multimedia form, characteristics of data, information and knowledge, Data gathering and evaluation methods, OMR, OCR, MICR, data transmission and reception.	20
UNIT-II	Fundamentals of computers	20
	History of computing, classification of computers, characteristics of a computer, components of computer, storage devices, connection systems, Binary number system, software and its classification, procedural oriented language, Object oriented programming language, compiler assembler and interpreter, operating system, and their kinds, DOS, WINDOS, Windows user interface system, Windows file management system, Data communication and Computer networks, Programming Language, Introduction to C, C++, Oracle, JAVA, VISUAL BASIC, RDBMS, HTML, Introduction to Networking, Standard Network Models, Network categories, Network data delivery, Network media and Hardware, Remote networking, Network data storage, Network operating systems.	
Unit-III:	Bioinformatics	20

	<p>Introduction to Bioinformatics, Its scopes and application, Internet and Bioinformatics, Knowledge discovery and Data Mining in Bioinformatics, Introduction to programming languages used in bioinformatics like PERL, BioPerl, Bio Java etc. Database concept, Types of Databases, Codd Rules, Data Normalization , Biological Databases, Data mining and Sequence Analysis, Database similarity search, Phylogenetic analysis, Submitting sequence in data bases. Sequence annotation, Structural Bioinformatics, Proteomic Data Analysis, Cheminformatics in biology, bioinformatics in the pharmaceutical industry and Drug designing, Sequence database searching for similar sequence, phylogenetic prediction, Prediction of RNA secondary structure, Gene prediction and regulation, Protein classification and structure prediction, Genome analysis. Techniques of comparison, Analysis packages, Immunotechnology, Domain Assignment and Searching, Comparative Protein modeling and Molecular Docking, Proteomics and Phenology. Genomic DNA, cDNA, rDNA, EST, GSS., PubMed, BioMed Central, Public Library of Science(PloS), CiteXplore. Sequence homology, identity and similarity, PAM and BLOSUM series, matrix derivation method and principles, Concept of sequence alignment, Needleman and Wunsch, Smith and Waterman algorithms.</p>	
<p>Books:</p> <ol style="list-style-type: none"> 1) Bioinformatics Sequence and Genome Analysis. By David W. Mount. CBS Publishers & Distributors(Pvt.) Ltd. 2) Bioinformatics. Concepts, Skills and Applications. By S.C. Rastogi, Namita Mendiratta, Parag Rastogi. 3) Molecular Modeling. Basic Principles and Application. By H.D.Holtje, W.Sipl, D. Rognan, G.Folkers. WILEY-VCH GmbH & Co.KGaA 4) Bioinformatics. A modern Approach. By Vittal R. Srinivas. Prentice Hall of India private limited. 5) A Textbook of Bioinformatics. By C. Subramanian. Dominant Publishers and Distributors 		

ASSIGNMENT Networking/ Web Designing/ Bioprogramming/ Animation.	20
UNIT & SEMINAR	20
	100

Paper-1.04 Optional Papers

SI No	Name of the Optional Papers
1	Bamboo Technology and Utilization of bamboo
2	Environmental Biotechnology and Bioresource
3	Genetic Engineering and Molecular Biology
4	Biochemistry
5	Microbiology and Food Biotechnology

<u>Bamboo Technology and Utilization of bamboo</u>	MARKS
UNIT-I Geographical distribution of Bamboo in India with special reference to its biodiversity, in the north east region. Geographical Information System (GIS): Basic -Principles of GIS; History of GIS; GIS Objectives;, Basic components of GIS: Hardware, Software, Data, people and Methods; Information domain: spatial and Non-spatial; Data Models: Vector Data Model and Raster Data Model; Data products, Data layers coverage and Entry; Attribute data attachment; Query and analysis; Spatial analysis; Creating a thematic map. Bamboo anatomy	15
UNIT-II Taxonomy of Bamboo: identification and characterization. Concept of priority species and selection criteria. Ecological function of Bamboo and its role in soil and water conservation Exotic species introduction and its role in bamboo economy.	15
UNIT-III Propagation of Bamboo .Cutting techniques of culm, sucker and rhizomes Vegetative Multiplication Centre (VMC). Nursery bed preparation, sapling establishment and . transplantation technique, plantation strategy, field evaluation.Fertilizer: Role of fertilizer and irrigation	15
UNIT-IV Concept of Tissue Culture infrastructure facilities, micro-propagation technique, macro proliferation. Concept of Green house, net house.- and poly house and their utility. Bamboo breeding and Cytogenetics. Conservation	15

Strategies.	
ASSIGNMENT	20
UNIT & SEMINAR	20
<u>Environmental Biotechnology and Bioresource</u>	
	MARKS
UNIT-I Concept of Biodiversity, Biodiversity at local, national and global level. Values of Biodiversity, measurement of biodiversity, threats to biodiversity, man animal conflict, genetic resources in animal and plant sciences in national context, global biodiversity strategy and its significance for sustainable agriculture, useful genes and their prospects of utilization through biotechnology, Convention on biological diversity	15
UNIT-II Biotechnology, Biodiversity and IPR, <i>in-situ</i> and <i>ex-situ</i> conservation, gene bank, Ramsar sites, sustainable development, Environmental Impact Assessment. Radiation Biology (Crompton effect, Auger effect, radiation effect on subcellular system, loss of reproductive ability in cells, effect on cell cycle, Effect on repair and recovery, acute radiation damage, late somatic effect, radiation therapy).	15
UNIT-III. Water purification, Rehabilitation of Natural Water Bodies, Bioassay methods in context to assessment of water quality, Water and its properties with special reference to North East India., Cycling of Nutrients in water systems, Enhanced reproductive technologies in sericulture, Algal Biomass estimation, Nygaard's Algal Indices, Palmer's Algal Pollution Indices, Species diversity indices, Sequential Comparison indices, waste water treatment plants, Biological Waste treatments, establishment of water monitoring laboratory. World Energy Resource –Consumption and Conservation	15
UNIT-IV Cryopreservation, Bioprospecting, Production of Primary and Secondary Metabolites. Production of biofertilizers, biological control of pests, pathogen and weeds, Single Cell Protein, Biofuels, Microbial Enhancement of Oil Recovery (MEOR), Conversion of Wood mass, Bioremediation, biodegradation, Removals of metal from water, biomining.	15

<u>Genetic Engineering and Molecular Biology</u>	MARKS
Unit-I Genome and its Organization Nuclear Genome, Chloroplast Genome, Mitochondrial Genome, Prokaryotic and Eukaryotic genome. Multigene family, various Pseudogenome, Viral genome, transcriptome,	6
UNIT-II Recombinant DNA and gene Splicing Conventional Genetic Recombination, Restriction Enzymes, Vectors, Probing and Cloning, Detection and selection of Clones., Harvesting Recombinant DNA Biotechnology for Public Health Engineering like production of Insulin, Interferon, Somatostatin, Human Growth Hormone Somatostatin, vaccines	6
UNIT –III Monoclonal Antibody and Hybridoma Cells Antigen-Antibody reaction, Hybridomas and preparation of Monoclonal Antibodies, Lymphokines, Application and Utility	6
UNIT-IV Methods of Gene Transfer :Agrobacterium tumefaciens mediated, Plant Viral vector, Transposable genetic Elements, Direct transformation. DNA transfer in Protoplast	6
UNIT-V Tool of Molecular Biology and Molecular Markers Blotting Techniques, DNA sequencing, Cell Fractionation, FISH, genomic Library, Restriction Enzymes, RFLP, RAPD, AFLP, SNP, Microsatellite, Minisatellite	6
UNIT –VI Stem Cell Biology and Regenerative Medicines Introduction to stem cells, Reprogramming of somatic cells, Application of iPS technology to Regenerative medicines. Developmental hematopoiesis, Epigenetic regulation of stem cell fate, Cryopreservation of cells, Cord blood banking and Long term storage of stem cells, FACS and its application, Neural stem cell and differentiation, Bone and Cartilage biology, Embryonic stem cells, Cancer stem cells.	6
UNIT-VII Nanobiotechnology Introduction, definition and historical evolution, types of nano materials, Properties and characterization, Application of nanobiotechnology.	6
UNIT-VII Enzyme Technology	6

Source of Enzyme, Enzyme extraction and Purification, Enzyme Immobilization, Biocatalysts reactors	
UNIT-VIII Gene Expression Transcription, Translation, Regulation of gene expression in prokaryotes and Eukaryotes, Operon Concept, Alteration in genetic materials (mutation). Standard Reporter System	6
UNIT –IX PCR, Its Types and Application, LCR, Antisense RNA technology, RNA interference, Ribozymes, Labelling of genome.	6
UNIT-X Intellectual Property Rights	6
ASSIGNMENT	20
UNIT & SEMINAR	20
	100



ज्ञान-विज्ञान विमुक्तये

प्रो. रजनीश जैन
सचिव

Prof. Rajnish Jain
Secretary



सत्यमेव जयते

विश्वविद्यालय अनुदान आयोग
University Grants Commission

(मानव संसाधन विकास मंत्रालय, भारत सरकार)
(Ministry of Human Resource Development, Govt. of India)

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D.O.No.F.1-1/2018(Journal/CARE)

December, 2019

Respected Sir/Madam,

University Grants Commission in its 543rd meeting held on 9th August, 2019 approved two Credit Courses for awareness about publication ethics and publication misconducts entitled "**Research and Publication Ethics (RPE)**" to be made compulsory for all Ph.D. students for pre-registration course work (**attached as Annexure**).

In view of the above, you are requested to ensure that the above two Credit courses may be made compulsory for all Ph.D. students for pre-registration course work undertaken in your University from the forthcoming academic session.

With regards,

Yours sincerely,

(Rajnish Jain)

TO THE VICE-CHANCELLORS OF ALL UNIVERSITIES

ANNEXURE

Course Title:

- **Research and Publication Ethics (RPE)**-Course for awareness about the publication ethics and publication misconducts.

Course Level:

- 2 Credit course (30 hrs.)

Eligibility:

- M.Phil., Ph.D. students and interested faculty members (It will be made available to post graduate students at later date)

Fees:

- As per University Rules

Faculty:

- Interdisciplinary Studies

Qualifications of faculty members of the course:

- Ph.D. in relevant subject areas having more than 10 years' of teaching experience

About the course

Course Code: CPE- RPE

Overview

- This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

Pedagogy:

- Class room teaching, guest lectures, group discussions, and practical sessions.

Evaluation

- Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
Theory		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
Practice		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	Total	30

Syllabus in detail

THEORY

- RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**
 - Introduction to philosophy: definition, nature and scope, concept, branches
 - Ethics: definition, moral philosophy, nature of moral judgements and reactions
- RPE 02: SCIENTIFIC CONDUCT (5hrs.)**
 - Ethics with respect to science and research
 - Intellectual honesty and research integrity
 - Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
 - Redundant publications: duplicate and overlapping publications, salami slicing
 - Selective reporting and misrepresentation of data
- RPE 03: PUBLICATION ETHICS (7 hrs.)**
 - Publication ethics: definition, introduction and importance
 - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
 - Conflicts of interest
 - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
 - Violation of publication ethics, authorship and contributorship
 - Identification of publication misconduct, complaints and appeals
 - Predatory publishers and journals

PRACTICE

- RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**

1. Open access publications and initiatives
 2. SHERPA/RoMEO 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.)**
 - 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.)**
 - A. Databases (4 hrs.)**
 1. Indexing databases
 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

- Bird, A. (2006). *Philosophy of Science*. Routledge.
- MacIntyre, 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>
- Bcall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>
- Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance*(2019), ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics_Book.pdf