AC_____

Item No. _____

UNIVERSITY OF MUMBAI

Syllabus for Ph.D.
COURSE WORK
in
BIOTECHNOLOGY
Program: Ph.D.
Course code: DSBT

Paper DSBT 101 and 102

With effect from the academic year **2020-2021**

VCD No: Exam/thesis/Univ/VCD/947 of 2018 dated 15th June 2018

AC_____ **Item No. _____**

UNIVERSITY OF MUMBAI

Syllabus for Approval

	Heading	**Particulars**
1	Title of the Course	Ph.D. Course work in Biotechnology
2	Eligibility for Admission	M.Sc. (55%) and PET in Biotechnology/Equivalent exams
3	Passing Marks	40%
4	Ordinances / Regulations (if any)	VCD No.Exam./Thesis/Univ./VCD/947 of 2018, dated 15th June 2018 & re-promulgation dated 15th Dec. 2018
5	No. of Years / Semesters	02 Semesters
6	Level	P.G. / ~~U.G./ Diploma / Certificate~~ **(Strike out which is not applicable)**
7	Pattern	~~Yearly~~ / Semester **(Strike out which is not applicable)**
8	Status	~~New~~ / Revised **(Strike out which is not applicable)**
9	To be implemented from Academic Year	From Academic Year 2020-2021

Date: Signature :

Name: **Dr. Anuradha Majumdar** (Dean, Science and Technology)
Dr. Archana Rath (Chairperson, Ad Hoc BOS in Biotechnology)

PREAMBLE

Biotechnology is the application of technology to various biological areas. Biotechnology applications can be seen in diverse fields like food processing, agriculture, waste management, energy production, genetically modified crops, healthcare to name a few. The remarkable progress made in the area of biotechnology means that it can be considered as a blend of technologies and an inter-interdisciplinary area activity involving basic sciences and aspects of engineering. The recent developments in the area of drug development and biologics have further enhanced the scope of biotechnology. The potential applications of biotechnology in the area of diagnostics, vaccine development and therapeutics are huge. To achieve excellence in the area by biotechnology, the University Of Mumbai, has been updating its graduate and post graduate syllabi.

The Course work in Ph.D. is mandatory for all candidates admitted for the Ph.D. Programme at the University of Mumbai. The Ph.D. course work in Biotechnology is meant to enhance the research potential of the Ph.D. candidate through academic, research and skill development in the chosen area of research.

The Ph.D. course work in Biotechnology shall consist of the following two papers:

- **Paper I (DSBT 101): Research Methodology**
- **Paper II (DSBT 102): Active participation, Academic Development & Skill Development**

Research Methodology paper is designed to provide the candidate with a solid foundation and prepare him/her for the actual Ph.D. research work. The second paper is meant to encourage candidate to actively participate in various conferences/ workshops etc., and to hone skills for handling of sophisticated instruments required for research work. Candidates can also opt for topics from various online courses available in SWAYAM and related platforms and get benefit of credit transfer. Hence, a good degree of flexibility and options have been provided in the course work to enable candidates to choose topics most relevant to their research area. It will cater to the vast different areas of research that the candidate may undertake by providing the required flexibility in taking the units within the course work

It is envisaged that the overall Ph.D. course work in Biotechnology will provide the necessary ground work and prepare the candidate to successfully take up the subsequent Ph.D. research work.

Dr. Anuradha Majumdar (Dean, Science and Technology)
Prof. Shivram Garje (Associate Dean, Science)
Dr. Archana Rath (Chairperson, Ad Hoc BOS in Biotechnology)
Dr. Deepali Karkhanis (Member)
Dr. Sneha Panvalkar (Member)
Dr. Seema Kokitkar (Member)
Dr. Tara Menon (Member)
Dr. Jayaprada R. Chunduri (Member)
Dr. Bhupendra Pushkar (Member)
Dr. Rajesh C. Patil (Member)

UNIVERSITY OF MUMBAI

Course work for Ph.D. degree in Biotechnology

Ph.D. Course work In Biotechnology

(For students admitted from the Academic year 2020 onwards)

Course code: DSBT

VCD No: Exam/Thesis/Univ/VCD/947 of 2018 dated 15th June 2018

Ph.D. course work shall be of 12 credits (01 credit = 15 hrs)

Paper Course	Paper Title	Max Credits
Paper I (DSBT 101)	Research Methodology	08
Paper II (DSBT 102)	Active participation, Academic Development & Skill development	04

Papers for Ph.D. Course Work#

Paper Course	Title	Details	Topics
Paper I (DSBT 101) **(08 credits)**	**Research Methodology** **1. Review of published research in the relevant field (04 credits)**	Topics relevant to the area of research to be chosen (selected in consultation with the research guide). The review shall be submitted by the candidate for evaluation.	

	2. Qualitative and Quantitative methods (01 credits) **3. Computer application (01 credits)** **OR** **(Instead of No. 2 & 3, Online courses as prescribed by RAC,** **max 02 credits)**	Lectures to be conducted □ Test /assignments will be done by respective resources persons □ To be completed in a formal way by the University through University Departments and also at identified Institutions where experts in the area of course work shall deliver requisite number of lectures. □ Record of attendance of the student shall be kept. The attendance of a candidate less than that prescribed by the University shall make the course null and void for the candidate. □ The course work may be completed either at the research centre/s or University departments or Premier Institutions like IIT, BARC HBNI, TIFR, ICSSR, IIM etc.	As per detailed syllabus
	4. Advanced level course/training (02 credits)	Use and validation of high-end instruments/ Attending training for advanced techniques.	
Paper II (DSBT 102) **(04 credits)**	**Active participation, Academic Development & Skill development**	Poster/oral paper presentations in an ISBN recognized Conference of National and International repute OR Workshop attendance of minimum cumulative 6 days **(max 02 credit)** **<u>AND</u>** ii) Handling of Lab instruments **(max 02 credits)**	

[#] The full Ph.D. Course work should be completed during the initial one or two semesters after joining for Ph.D.

DETAILED SYLLABUS

FOR PAPER I (DSBT 101) – 08 credits			
Units	**Topics**	**Lectures (hours)**	**Max Credit/s**
Unit I **Review of published research in the relevant field** **(60 hrs)**	Topics relevant to the area of research to be chosen (in consultation with the research guide). The review shall be submitted by the candidate for evaluation.	**60**	**04**
Unit II **Qualitative and Quantitative methods** **(15 hrs)**	Biostatistics Introduction and scope of statistics in biological studies and basic concepts. Collection of data, by different sampling methods: Simple random sampling, stratifies random sampling and systemic sampling. Measures of central tendency; Mean, Median and Mode. Measures of Dispersion: Variance/ standard deviation, coefficient of variation and standard error. Confidence limits for mean and proportion. Probability and Basic concepts: Normal and binomial distribution. Correlation and regression analysis for a bivariate data: Scatter diagram **OR** Biostatistics Test of Hypothesis: Null hypothesis, alternate hypothesis, test statistics, Type I and Type II errors, level of significance and critical region. Z test: for a single sample, two samples and two sample proportion. t-test a single sample, two samples and testing the significance of the correlation. Coefficient: t paired test, x2 test: As a goodness of fit and in 2x2 contingency test **OR** CRISPER CAS and Molecular cytogenetics CRISPER CAS: History of its discovery, elucidation of the mechanism including introduction to all the molecular players development of applications for in vivo genome engineering for genetic studies, promise of the technology as a next generation therapeutic method Introduction to chromosomal abnormalities. Advanced Cytogenetic techniques and applications - FISH, M-FISH, SKY, CGH, Microarrays principle, methodology. Molecular Approaches for Delineating, Marker Chromosomes, Prenatal	**15**	**01**

	Diagnosis of Common Aneuploidies, Preimplantation FISH Diagnosis of Aneuploidies, Molecular Cytogenetics in Reproductive Pathology Interphase FISH Studies of Chronic Myeloid Leukemia, FISH Detection of HER2 Amplification in Breast Cancer, Chromogenic In-Situ Hybridization and FISH in Pathology. **OR** Diagnostic Microbiology – **Techniques –** Molecular amplification techniques • Target amplification systems • Probe amplification systems • Signal amplification PCR in molecular diagnostics; viral and bacterial detection Quantitation of organisms – internal controls, external standards, calibrators, absolute and relative quantification Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing Detection and identity of microbial diseases Direct detection and identification of pathogenic-organisms/ viruses E.g. TB and HIV Clinical utility of molecular diagnostics tests (NAAT) for Hepatitis and AIDS. Molecular identification of fungal pathogens Pharmacogenetics **OR** Antigen- antibody interactions Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques: RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence microscopy, flow cytometry and immunoelectron microscopy; biosensor assays for assessing ligand –receptor interaction; CMI techniques: lymphoproliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, transgenic mice, gene knock outs. OR Techniques of Enzyme purification and studies/enzyme – **Techniques of purification** – Based on Molecular Size: Dialysis/ ultrafiltration density gradient centrifugation, size exclusion chromatography Based on Solubility of Proteins: Isoelectric precipitation, salting out Based on electric charge: Ion exchange chromatography, Electrophoresis- capillary electrophoresis, 2D electrophoresis Based on Adsorption Properties: Adsorption and Affinity chromatography **Other techniques –** Immobilized metal ion affinity chromatography, Hydrophobic interaction chromatography, Reversed phase chromatography and Chromatofocusing.		

	Enzyme engineering – Introduction, Objectives, Principles, Examples and Steps involved in enzymes engineering. Random mutagenesis and molecular breeding of DNA. Computational tools for designing, random and de novo methods of enzyme design and engineering enzymes. Recent advances in Rational approaches for Enzyme engineering. Applications of enzyme engineering **OR** OMICS: Transcriptomics, Lipidomics, Metabolomics – 1. Introduction to Transcriptomics, Lipidomics And Metabolomics, Glycomics, Pharmacogenomics 2. Technique used in Lipidomics- Mass Spectroscopy,Pcr, Capillery Electrophoresis, Next Generation Sequencing, Biosensor Techniques and microarrays 3. Technique used in Metabolomics- Mass Spectroscopy, Electrophoresis, chromatography= ion exchange, size exclusion and affinity, microarrays. 4. Technique used in Transcriptomics- Mass Spectroscopy, northern blotting, DDRT-PCR, chromatography= ion exchange, size exclusion and affinity, microarrays, 5. Application of transcriptomics metabolomics and lipidomics in human diseases –screening, testing and treatment of diseases (in clinical applications,personalised medicine, infectious diseases)		
Unit III **Computer Applications** **(15 hrs)**	Bioinformatics – Bioinformatics basics: Computers in biology and medicine; Introduction to Unix and Linux systems and basic commands; Database concepts; Protein and nucleic acid databases; Structural databases; Biological XML DTD's; pattern matching algorithm basics; databases and search tools: biological background for sequence analysis; Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; resources at EBI; resources on web; database mining tools. DNA sequence analysis: gene bank sequence database; submitting DNA sequences to databases and database searching; sequence alignment; pairwise alignment techniques; motif discovery and gene prediction; local structural variants of DNA, their relevance in molecular level processes, and their identification; assembly of data from genome sequencing. **OR** Bioinformatics – Multiple sequence analysis; multiple sequence alignment; flexible sequence similarity searching with the FASTA3 program package; use of CLUSTALW and CLUSTALX for multiple sequence alignment; submitting DNA protein sequence to databases: where and how to submit, SEQUIN, genome centres; submitting aligned sets of sequences, updating submitted sequences, methods of phylogenetic	**15**	**01**

	analysis. Protein modelling: introduction; force field methods; energy, buried and exposed residues; side chains and neighbours; fixed regions; hydrogen bonds; mapping properties onto surfaces; fitting monomers; RMS fit of conformers; assigning secondary structures; sequence alignment- methods, evaluation, scoring; protein completion: backbone construction and side chain addition; small peptide methodology; software accessibility; building peptides; protein displays; substructure manipulations, annealing. **OR** <u>Introduction to systems biology-</u> Systems biology towards systems level understanding of biological systemsSystems structure, systems dynamics,systems design and control, systems project Models and Modelling systems in systems biology What is a model? Key properties of models,Basic of computational models, networks, data integration, standards, and model organism Revised Syllabus for M.Sc. (Biotechnology) Semester III and IV Page 27 of 37 PSBTP 402-PRACTICALS : 1. Gel electrophoresis of lipids (lipoproteins exrtacted from various sources) to separate and identify the lipid fraction 2. Preparation of report based on -Databases and data repositories used in systems Biology 3. Detection assay for gene expression using micro array and qRT –PCR (demonstration) 4. Identification of protein using analytical technique Mass spectroscopy (demonstration) REFERENCES-Sr no Title of the book Author Publisher 1. Bioinformatics and functional genomics (2003) Jonathan Pevsner John wiley & sons Publications 2. Integration of omics approaches and systems biology for clinical applications Antonia Vlahou, Harald Mischak, Jerome Zoidakis, Fulvio Magni. Wiley publications 3. Omic technologies : genomics, transcriptomics, proteomics and Richard P. Horgan And Louise C. Kenny Scientific advisory committee (sac) , the obstetrician and Perturbation of biological systemsand 'Omics' as Quantitative high throughput experimental tools for systems biology Standards and formats for systems biologyComputational Databases and software tools in systems biology. Biological networks: metabolic networks, gene regulatory networks, PPI networks, genetic interaction (GI) networks, and signaling networks **OR** <u>Data mining and application of systems biology</u> Introduction to Knowledge of discovery in databases (KDD) What is knowledge, need for KDD,KDD process outline, concept and goals. Data Mining methods: Statistics – classification, correlation, association analysis, regression, and clustering Machine learning – Symbolic and statistical approaches. Text mining, and Pattern evaluation. Data mining in scientific applications Application of systems biology : 1. Systems biology to systems medicine. 2. Application of systems biology in drug discovery and development 3. Systems biology and synthetic biology		

OR			
Online Courses (instead of Unit II & III)	Topics relevant to the candidate can also be selected by the respective RAC from other relevant credited offline and online courses from portals like SWAYAM, NPTEL etc. If relevant online courses are not available in these portals, then other reputed online portals like COURSERA, EDX can be considered (provided approved by RAC).	**30**	**02**
Unit IV **Advanced level course/ training (30 hrs)**	Use and validation of high-end instruments and interpretation of data (a minimum 04 instruments)– HPLC, HPTLC, GLC, PCR, Spectrocopy, Flow cytomerty, MS, Microarray, Microscopy, FTIR, NGS, NMR **OR** Attending training for advanced techniques. May be completed either at the research centre/s, or University departments or other recognized research centres, or premier institutions such as IIT, BARC, TISS, ICSSR, TIFR etc. provided it is conducted in a formal way.	**30**	**02**

DETAILED SYLLABI FOR PAPER II (DSBT 102) – 04 credits

Paper Course	Details	Max Credit/s
Paper III (DSBT 102) Active participation, Academic Development & skill development **(04 credits)**	Poster/oral paper presentations in an ISBN recognized Conference of National and International repute/ Workshop attendance of minimum cumulative 6 days (Certificate of presentation/participation will be mandatory) **AND** Training & Handling of Lab instruments. Focus shall be on hands- on- training and handling of sophisticated instruments by the candidate. A minimum of 04 major instruments, assigned by the Research Guide, will be handled by the candidate for minimum 08 hours a week. A record of the same shall be maintained. The evaluation will be the Research Guide based on the number of times the instrument is handled/used for analysis.	**02** **02**

Evaluation and Assessment Methods

The rules and regulations regarding the eligibility and process of the entrance examination, interview, registration and course work for the Ph. D. programme are given in the **VCD No:Exam/Thesis/Univ/VCD/947 of 2018 dated 15th June 2018 & re-promulgation dated 15th Dec. 2018.**

The course work shall be treated as prerequisite for Ph.D. preparation. The Ph.D. Course work should be completed during the initial one or two semesters after admission for Ph.D.

Minimum attendance and the mode of assessment for the evaluation of coursework will be as per the VCD Guidelines.

The grades will be finalized after a combined assessment by the RAC and the Department. The final grades will be communicated to the Head of Centre and to the University.

A Ph.D. scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC 7-point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the course work in order to be eligible to continue in the programme and submit the thesis.

There shall be a **Research Advisory Committee (RAC)** for each Ph.D. student, which shall be constituted immediately after the admission of the candidate. The composition and responsibilities of RAC shall be as per the VCD.

Before submitting the Research Proposal to the University for Topic Approval, the selected Ph.D. candidate shall make a formal Presentation of his / her Research Proposal in front of the RAC. After incorporating the suggestions (if any) of RAC, the final copy shall be submitted to the University for consideration by **R.R.C.** Letter of approval from the concerned Research Centre duly signed by all the members of RAC evaluation committee regarding the presentation made by the candidate shall be attached along with the research proposal copy to be submitted for Topic Approval.

Kindly Note:

1. The record of the evaluation is to be maintained till the candidate is awarded his/her Ph.D. degree by the University.
2. After completion of the course-work, the certificate of completion of course work shall be submitted to the University as per the prescribed format:

Name of the research centre

Certificate

This is to certify that Mr./Ms./Mrs.(Surname) ……..(First name)…….. (Second name)…….. has been a regular student of Ph.D. with registration number …….. He/She has attended the Ph.D. course work conducted at the recognized research centre/department from…… to ……during the year …… He/She has successfully completed the Ph.D. course work prescribed by the University of Mumbai. He/She secured ……. grade in ……..point scale.

Date:	Guiding teacher	Head of the Department/Principal
Seal	Name:	Name:

*In addition to the Ph.D. course work, a course on **Research and Publication Ethics (RPE)** is compulsory for all Ph.D. students as pre-registration course work from the forthcoming academic session, as per UGC Circular D.O.No.F.1-1/2018(Journal/CARE) of Dec 2019.*
RPE is to be conducted by the Research centre/department.
The details of pre-registration course work on Research and Publication Ethics (RPE) is provided in the ANNEXURE.

Suggested Reading:

1. S. P. Gupta, Statistical Methods, (45th Revised Edition), Publisher SCHAND
2. William G. Cochran, Sampling Techniques (3th Edition), Wiley and sons
3. Boris V. Gnedenko, Theory of Probability (6th Edition), CRC Press, 13-May-1998
4. Oscar Kempthorne, Klaus Hinkelmann, Design and Analysis of Experiments, Volume1: Introduction to Experimental Design, 2nd Edition, ISBN: 978-0-471-72756-9 December 2007
5. Acheson Johnston Duncan, Quality Control and Industrial Statistics (5th Edition), Irwin; 5 edition January 1, 1986
6. BK Mahajan, Methods in Biostatistics (7th Edition), Published December 1st 2008 by JP Medical Ltd
7. Mohanraju, P., Makarova, K. S., Zetsche, B., Zhang, F., Koonin, E. V., & Oost, J. V. (2016). Diverse Evolutionary Roots and Mechanistic Variations of the CRISPR-Cas Systems. Science, 353(6299). doi:10.1126/science.aad5147.
8. Lander, E. (2016). The Heroes of CRISPR. Cell, 164(1-2), 18-28. doi:10.1016/j. cell.2015.12.041
9. Ledford, H. (2016). The Unsung Heroes of CRISPR. Nature, 535(7612), 342-344. doi:10.1038/535342a.
10. Microarray and Microplates: Applications in biomedical sciences Shu Ye, Ian Day, 2003, Bios Scientific Ltd, oxford.
11. Human Molecular Genetics. Tom Strachan and Andrew Read, 2004, 3rd Edition, Garland Science.
12. Introduction to human molecular genetics. Jack Pasternak, 2005, 2nd Edition, Wiley publication.
13. Molecular Imaging Theranostics, 4(4), 386-398. doi:10.7150/thno.8006 Coleman, W. B., & Tsongalis, G. J. (2010). Molecular Diagnostics: for the Clinical Laboratorian. Totowa, NJ: Humana Press.
14. Molecular Microbiology Diagnostic Principles and practice third edition, David H. Persing and Fred C. Tenover Copyright _ 2016 by ASM Press
15. Methods in Molecular Biology, Vol. 204: Molecular Cytogenetics: Protocols and Applications, Edited by: Y. S. Fan © Humana Press Inc., Totowa, NJ 2001
16. Molecular Biotechnology – Principles and applications of recombinant technology, Glick 4th edition 2010
17. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2006). Kuby Immunology. New York: W.H. Freeman.
18. Medical Microbiology, Anantnarayan
19. Brostoff, J., Seaddin, J. K., Male, D., & Roitt, I. M. (2002). Clinical Immunology. London: Gower Medical Pub.
20. Text Book of Medical Biochemistry, Praful Godkar. Bhalani Publishers
21. Biochemistry by Lehninger, 2 nd Ed, Kalyani publication.
22. Trevor Palmer – Understanding Enzymes-E. Horwood (1991) Chapter 16. Pgs 306-314
23. Protein Purification Principles, High Resolution Methods, and Applications, 3 rd Edition, edited by Jan-Christer Janson, Wiley.

24. Young Je Yoo, Yan Feng, Yong- Hwan Kim, Camila Flor J. Yagonia Fundamentals of Enzyme Engineering. (2017) Springer Netherlands. Chapter 1 – History of Enzyme engineering pgs 3- 12. Chapter 8 – Engineering tools for enzymes pgs 86-99
25. Biomass, Biofuels, Biochemicals: Advances in Enzyme Technology. Ram Swaroop Singh, Reeta Rani Singhania, Christian Larroche Chapter 12 pgs 325-347 and Chapter 15 pgs 419-451.
26. Current Developments in Biotechnology and Bioengineering. Sudhir Singh, Ashok Pandey, Sudesh Kumar.
27. Synthetic Biology, Cell Engineering and Bioprocessing Technologies Chapter 7 pgs 165-188.
28. Foundations of systems biology by Hiraoki Kitano, MIT press
29. Systems Biology A Textbook, Second Edition- by Edda Klipp Wolfram Liebermeister Christoph Wierling Axel Kowald. Wiley-VCH publication
30. System biology, Karthik Raman and Nagasuma Chandra, RESONANCE February 2010
31. A New Approach to Decoding Life: Systems Biology, Trey Ideker, Article in Annual Review of Genomics and Human Genetics · February 2001
32. Systems Biology and Synthetic Biology by Pengcheng Fu
33. System Biology a textbook by Edda Klipp
34. Analysis of biological networks by Bjorn .Junker, Falk Schreiber Wiley interscience
35. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
36. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience.
37. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell.
38. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
39. Lesk, A. M. (2004). Introduction to Protein Science: Architecture, Function, and Genomics. Oxford: Oxford University Press.
40. Mount, D. W. (2001). Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
41. Baxevanis, A. D., & Ouellette, B. F. (2001). Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins. New York: Wiley-Interscience.
42. Pevsner, J. (2015). Bioinformatics and Functional Genomics. Hoboken, NJ.: Wiley-Blackwell.
43. Bourne, P. E., & Gu, J. (2009). Structural Bioinformatics. Hoboken, NJ: Wiley-Liss.
44. Lesk, A. M. (2004). Introduction to Protein Science: Architecture, Function, and Genomics. Oxford: Oxford University Press.
45. Integration of Omics approaches and system biology for clinical applications by Antonia Vlahou, Harald Mischak, Jerome Zoidakis, Fulvio Magni. (Wiley publications).
46. Knowledge discovery and data mining in biological databases by VLADIMIR BRUS I C, The Knowledge Engineering Review, Vol. 14:3, 1999, 257-277.
47. Data mining techniques for the life sciences volume 609 springer protocols, Humana press by Olivier Ocarugo.
48. Integration of Omics approaches and system biology for clinical applications by Antonia Vlahou, Fulvio Magni, Harald Mischak, Jerome Zoidkas.
49. The road from systems biology to systems medicine by Olaf Wolkenhauer, Charles Auffray, Robert Jaster, Gustav Steinhoff and Olaf Dammann.
50. Advanced Systems Biology Methods in Drug Discovery and Translational Biomedicine by Jun Zou, BioMed Research International Volume 2013.

ANNEXURE

In addition to the Ph.D. course work, a course on Research and Publication Ethics (RPE) is compulsory for all Ph.D. students as pre-registration course work from the forthcoming academic session, as per UGC Circular D.O.No.F.1-1/2018(Journal/CARE) of Dec 2019.
RPE is to be conducted by the Research centre/department.
The rules and regulations regarding the eligibility and course work details is as per **UGC Circular D.O.No.F.1-1/2018(Journal/CARE) of Dec 2019.**
The course work shall be treated as pre-requisite for Ph.D. registration.

About the course

Course code: CPE-RPE-02 Credits, 30 hours

Overview:

- This course comprises of six modules (THEORY: RPE 01-03; PRACTICE: RPE 04-06), each module has 4-5 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.
A Ph.D. scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC 7-point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the course work in order to be eligible for Ph.D. registration.

Pre-registration course work on Research and Publication Ethics (RPE)

Module	Topics	Lectures (hours)
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	03
RPE 02	Scientific conduct 1. Ethics wrt 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 misinterpretation of data	05
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, concepts, 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	07
RPE 04	Open Access Publishing 1. Open Access Publications and initiatives 2. SHERPA/ RoMEO online resource to check publisher copyright & self-achieving policies 3. Software tools to identify predatory publications developed by SPPU 4. Journal finder/ journal suggestion tools viz., JANE, Elsevier Journal Finder, Springer Journal Suggester, etc	04
RPE 05	Publication Misconduct (A) Group Discussions (02 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 (02 hrs) Use of plagiarism software like Turnitin, Urkund and other open source software tools	04

RPE 06	Databases and Research Metrics (A) Databases (04 hrs) 1. Indexing databases 2. Citation databases: Web of Science, Scopus etc. (B) Research Metrics (03 hrs) 1. Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score Metrics: h-index, g index, i10 index, all metrics	07

Kindly Note:

1. The record of the evaluation is to be maintained till the candidate is awarded his/her Ph.D. degree by the University.
2. After completion of the RPE course-work, the certificate of completion of course work shall be submitted to the University as per the prescribed format:

Name of the research centre

Certificate

This is to certify that Mr./Ms./Mrs. (Surname) ……..(First name)…….. (Second name)…….. has been a regular student of Ph.D. He/She has attended the course work on **Research and Publication Ethics (Course code: CPE-RPE)** conducted at the recognized research centre/department from…… to ……during the year …… He/She has successfully completed this course as part of the pre-registration course work prescribed by the University of Mumbai. He/She secured ……. grade in ……..point scale.

Date: Guiding teacher Head of the Department/Principal
Seal Name: Name: