

NEHRU GRAM BHARATI

(Deemed to be University)



Ph.D. Course Work Syllabus

FACULTY OF SCIENCE

Ph.D. Course Work Syllabus

Course work of at least one semester shall be the pre-requisite for the Ph.D. Degree which will include a course as approved for the subject concerned. The Research Scholar's 75% attendance is mandatory for the Course Work. However, a relaxation of 15% in the attendance may be granted by the Hon'ble Vice Chancellor for the justified reasons.

All applicants admitted to the Ph.D. programme shall fulfill the minimum requirement of residence of 36 months in the recognized centre by the Deemed to be University.

The Course Work shall consist of the following four papers of 4 credits each:

| Sl.No | Paper | Credit | Unit |
|-------|------------------------------------|--------|------|
| 1 | A. Research Methodology | 04 | 05 |
| | B. Research Publication and Ethics | 02 | 05 |
| 2 | Computer Application | 04 | 05 |
| 3 | Gram Pravas | 04 | 05 |
| 4 | Advances in the Subject | 04 | 05 |

Examination and Evaluation of the course-work:

(a) Students shall compulsorily attend the course work, failing which they will not be allowed to appear for the end semester examination. In case of students who could not attend the course work due to medical reason or under extraordinary circumstance or have less attendance a separate test shall be conducted after attending the intensive course work with the permission of the Dean of the faculty on recommendation of the Head of the Department. A prescribed fee by the Deemed to be University will be charged from such students.

(b) There shall be one End semester examination of 2 hours duration in each course covering the entire syllabus prescribed for the course at the end of the semester only. The End semester examination shall be normally a written semester based examination. The End semester examination and evaluation shall be conducted by the Deemed to be University.

(c) A candidate who has less than 75% attendance shall not be permitted to sit in examination however, it shall be open to the V.C. to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons on payment of prescribed fee and such exemptions shall not under any circumstances be granted for attendance below 65%.

(d) The Director Research Centre shall announce the names of all students who will not be eligible to take the examinations.

Marks and Grading of the course-work:

(a) A candidate has to secure a minimum of 50 percent of marks or Letter Grade "B" in six point scale in End semester Examination in the course to pass in that course. A candidate who has not secured a minimum of 50 percent of marks or Letter Grade "B" in six point scale in a course shall be deemed to have failed in that course. A failed student shall be allowed to repeat the semester examinations for a maximum of one time and he/she has to pass the Pre Ph.D. course before submission of the Ph.D. thesis. The sessional marks obtained by the student shall be carried over for declaring the result.

(b) The percentage of marks obtained by a student in a course will be indicated by a grade point and a letter grade. A six (6) point scale shall be used for the evaluation of the performance of the student as given below:

| MARKS | GRADE POINT | LETTER GRADE |
|------------------|--------------------|---------------------|
| 75-100 | 5.50-6.00 | O |
| 65-74 | 4.50-5.49 | A+ |
| 60-64 | 4.00-4.49 | A |
| 55-59 | 3.50-3.99 | B+ |
| 50-54 | 3.00-3.49 | B |
| BELOW 50% | 0.00-2.99 | F |

(c) The system of evaluation shall be transparent and students shall have the right to examine their marked answer scripts.

Paper - I PART-A: RESEARCH METHODOLOGY

(4 Credits)

COURSE OUTCOME

As a core course, this module prepares students of all 05 subjects to handle researches in their own subject, in Inter Disciplinary and Multi Disciplinary areas including Thrust Areas of Research notified by our University. The students are armed in this course with fundamentals of why, which, what where and how to do Research leading to a Ph.D. Degree. Starting from an introduction to Research Methodology, objectives and types of the good research, how to define the research problem, get insights of designing research in overall and sample surveys where so relevant, emphasis is laid on how to collect, collate and describe data using appropriate measurement scales in their tabular / graphical representations. Then parametric tests like z, t, F, posthoc ANOVA and non-parametric 2 tests like X tests are discussed with their merits and limitations along with correlation / regression analysis for testing the hypotheses. Finally how to write a research report, research papers and thesis with thorough presentation of State of Art literature review using UGC CARE LIST Journals, International Journals, SHODH GANGA, DELNET resources including Govt. and Private Sector Websites, Blogs etc. is explained with practical examples available at Central Library of our University and on Internet.

SYLLABUS

Unit I - Introduction to Research:

Fundamental of research, Scope of Research, Types of Research, Sources of Research Problem, Qualities of good research problem, Identification of good problem, Scientific research characteristics and steps of scientific research, Scientific research problems

Unit II - Research Methods & Design:

- (a) Traditional Methods - Historical, Institutional, Legal, Philosophical, Comparative, Ethical methods etc.
- (b) Modern Methods - Survey of Literature, Sampling method, Questionnaire, Schedule etc, Interview method and Focus Group discussion, Observation Method, Case Study method, Content analysis, Statistical Method, Experimental Method, Brainstorming Techniques etc.

Research Design Basic Principles; Need to research Design; Features of good design; Important concepts relating to research design; Observation and Facts; Laws and Theories; Prediction and explanation, Induction, Deduction, Development of Models. Developing research plan Exploration, Description and Experimentation Determining experimental and sample designs.

Unit III: Tools & Techniques of Data Collection analysis and Interpretations:

- I. Meaning of Population and Sample; Sampling Methods- Random, Stratified, Purposive
- II. Tool of Data Collection: (a) Primary, Secondary and Tertiary Data (b) Schedule (c) Observation (d) P.R.A.
- III. Type of Data (a) Primary, Secondary and Tertiary Data (b) Construction and adaptation of instruments, Administration of questions and tests, Tabulation of data (c) Data organization in SPSS and Excel (d) Graphical representation of data.
- IV. Analysis of Data (a) Measure of Central tendency; Standard Deviation & Standard error; Measure of variability, Correlation and its computation; ANOVA (b) Discussion and Discussion and Interpretation of results (c) Testing of 2 Hypotheses; Logical and Statistical Techniques like chi Square test (X^2) and Student t-test. Interpretation of results (c) Testing of 2 Hypotheses; Logical and Statistical Techniques like chi Square test (X) and Student t-test.

Unit IV: Synopsis, Reporting and Thesis Writing

What is synopsis? How to write synopsis? Qualities of good synopsis; How to select research problems? Reporting and thesis writing- Structure and components of reports/scientific reports; Type of report Technical Reports and thesis; Significance; Different steps in the preparation; Layout, structure and language of typical reports; Illustrations and tables; Bibliography, referencing and footnotes; Oral presentation - Planning - Preparation - practice - Making Presentation; Use of visual aids; Transparencies/PowerPoint for effective Communication; Criteria for the evaluation of the research report/project report; Research paper writing, conflict of interest, transfer statement.

Unit V: Application of result; Ethics & Future

Environmental and Societal impact; Ethical issues in Research; Ethical Committees; Copy right; Royalty; Intellectual property right and patent Law; Trade Related aspects of Intellectual Property Right; Reproduction of published material; Plagiarism; Citation and acknowledgement; Reproducibility and Accountability; Preparation of Projects; Society oriented research linkages; Capacity building; Research Collaborations (MOU); Research Visits.

REFERENCES:

1. Garg, B.L., Karadia, R., Agarwal, F. And Agarwal, U.K., 2002 An Introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.

3. Sinha, S.C. and Dhiman, A.K. 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods; the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.
6. Bagchi, Kanak Kanti (2007) Research Methodology in Social Sciences: A Practical Guide. Delhi, Abhijeet Publications.
7. Sharma, B.A.V., et al., (2000) Research Methods in Social Sciences, New Delhi, Sterling Publishers.
8. B.A.V. Busha, C.H. and Harter, S.D. (1980) Research Methods in Librarianship, New York, Academic Press
9. Cooper, R. Donald and Pamela S. Schindler (2003) Business Research Methods, Delhi, Tata McGraw-Hill.
10. Flyvbjerg, Bent (2001) Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.
11. Ghose, B.N. (1999) Scientific Method and Social Research, New Delhi. Gilbert, Nogel (1993) researching Social life, New Delhi, Sage Publication.
12. Goodde and Hatte (1952) Methods in Social Research, New York, McGraw-Hill.
13. Gopal, M.H.(1970) An Introduction to Research Procedures in Social Sciences, Bombay, Asia Publishing House.
14. Henn. Malt, Mark Weinstein and Nick Foard (2006) A Introduction to Social Research, New Delhi, Vistaar Publications.

Paper - I PART-B: RESEARCH AND PUBLICATION ETHICS

(2 Credits)

COURSE OUTCOME

After completing the core course of 1) Research Methodology (RM), the course of RM is reviewed here for its every chapter on the basis of UGC booklet available on the UGC website "Good Academic Research Practices (GARP)" already notified and adopted by our University using Internet resources as practical examples. Contrasting philosophies for research, ethical misconducts in researches are discussed threadbare Misinterpretations & Impersonifications Fabrication of Data, Plagiarism, conflicts of interest, misuse of techniques for data collection, Coding, Collation, description / representation, analysis and falsification of results, etc. Coming to publications stage, predatory journals vis a vis UGC CARE LIST Journals, their Impact Factor (IF), metrics of Research Journals and researchers, indexing databases etc. are reviewed with emphasis on avoiding use of redundant Journals in literature survey as well as for purposes of

publications of research papers. For its implementation, role of recently instituted "Annual Research Integrity Assessment Committees (ARIAC)" meetings by our University to spot ethical misconducts right on the time of ongoing Ph.D. work being conducted by all Ph.D. Scholars is emphasized as executed by their "Departmental Research Committee (DRC's)" to regulate the research work in line with Govt. Academic Research Practices (GARP) 2020 booklet published by UGC, GOI.

Syllabus

| Module | 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 | Database & Research Metrics | 7 |
| | Total | 30 |

DETAILED SYLLABUS

Theory

RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)

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

RPE 02: SCIENTIFIC CONDUCT (5 hrs)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconduct; 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)

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 behaviour 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 (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 tool viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

RPE 05: PUBLICATION MISCONDUCT (4 hrs)

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 (2hrs.)

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

RPE 06 DATABASES AND RESEARCH METRICS (7 hrs.)

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 JournalS Citation Report, SNIP, SJR, IPP, Cite Score.
2. Metrics : h-Index, g index, i10 index altmetrics.

REFERENCES

1. Good Academic Research Practices 2020 : <https://ugc.ac.in>
2. <https://www.google.com>
3. <https://scholar.google.com>
4. <https://in.linkedin.com>
5. <https://delnet.in>

Paper - II
COMPUTER APPLICATIONS
Course Outcome

(4 Credits)

With ICT pervading every field of Knowledge, each Ph.D. scholar has to be familiarized with knowledge of fundamentals of present day computers/Laptops/Desktops/Android Phones and use of MS-Office or open office and other basic packages required for completing his/her Ph.D. degree. This Course arms the student to familiarize with present day Computers, their capabilities in hardware and software with emphasis on operating system, document preparation package, database package, presentation package etc. It enables the Scholars to prepare his/her presentations, write research papers, Poster presentations in Seminar & Conferences. They will acquire basic skills for Storage of Primary & Secondary data with full analytical power, thesis writing and its Final presentation before the Panel of Examiners.

SYLLABUS

Unit - I: Definition and Characteristics, Windows and Linux (Latest Version) Microsoft Word 2007

Definition and Characteristics of Computers: Classification of Computers; Application of Computers; Hardware; Software; Functional Units of a Computer System; Computer Architecture; Bit, Nibble and Byte. **Windows:** Introduction to Windows Operating System; Windows Features; Starting Windows; Parts of Windows Screen; Shortcuts in Windows; Windows Applets;

Windows : My Computer; Working with files and Folders; what is MS-DOS? Booting Process; The DOS Directory Structure; Referencing Group of files; Command Syntax; Types of Commands;

Microsoft Word (Latest Version): Introduction to Word; Starting Word; What is Mail Merge ?; Word Tables.

Unit II: Microsoft Excel; (Latest Version)

Excel Features; Entering data into a Cell; Entering Numbers; Spreadsheets Operations; Freezing Window Panes; Excel Offers Several Methods for Selecting Cells; Erasing the Content of A Cell; Formatting Cells from the Home Tab; The Format Painter; Formulas and Functions; Using Logical Functions; Date and Time Functions; Math and Trigonometric Functions; Statistical Functions; Copying Formulas; Charts; Creating a New Embedded Chart; Type of Charts; Formatting Chart Elements from the Format tab.

Unit - III: Microsoft PowerPoint (Latest Version)

What is Presentation? Introduction to PowerPoint; Starting PowerPoint; PowerPoint Views; Save a Presentation; Exiting PowerPoint; Working with Slides.

Unit IV: Introduction to Internet and E-Mail

Hardware requirement; to connect to the Internet; Types of Connections; Internet Service Providers; Internet Addressing; Resource Addressing; The World Wide Web; E-Mail.

Unit V: Networking Concepts

What is a Networks?; Uses of Computer Networks; Network Topologies; Network Hardware and Software.

Suggested Readings & references:

- 1) BPB PUBLICATION,COMPUTER FUNDAMENTALS,SIXTH EDITION COMPLETE BY PRADEEP K SINHA & PRITI SINHA.
- 2) PHI PUBLICATIONS,FUNDAMENTALS OF COMPUTERS, SIXTH EDITION BY V.RAJARAMAN & NEEHARIKA ADABALA.
- 3) BPB PUBLICATIONS, 2010, MS-OFFICE 2007 TRAINING GUIDE BY AUTHOR (S.JAIN).
- 4) MICROSOFT OFFICE 365 FOR BEGINNERS BY AUTHOR (JEFT OWEN)
- 5) MASTERING MS-OFFICE, PUBLISHER:V&S PUBLISHERS,AUTHOR- KUMAR BITTU.

Paper - III

MODULE 4: GRAM PRAVAS

Course Outcome

(2 Credits) (M. Marks 50)

This module aims to expose Ph.D. Scholars how to collect, collate, analyze primary field data acquired through practical experiences in regard to the realities of Indian villages by door to door contact with village households, get current status of their economic, educational and social levels in view of the govt. claims and schemes, set-up awareness indicator and its efficacy vis a vis their aspirations as citizens of Modern India. It's theme (Anx 1) is to be responded with the primary data as per Anx 2 to submit their project report answering in detail all the points of checklist [Anx 2] forming a database and be motivated to involve wherever so possible need-based research for execution of New Education Policy2020 of GOI.

Annexure-1

THEME OF THE GRAM PRAVAS MODULE

1. Title of the Practice : Gram Pravas

2. Objectives of the Practice : Accountability of the Universities towards the society and the Nation has been a long cherished desire of the University Grants Commission. This aspect has remained nearly untouched as regards the concern of the Universities towards rural masses. Our Gram Pravas program has yielded wonderful results in this area.

3. The Context : We are fully aware that our villages have still to get benefits of the Govt. schemes designed and meant for them. It is responsibility of the Universities to make an audit on this account and do everything necessary to bring the results of the Govt. schemes close to villages and the villagers. Ours is a rural University, therefore, we are deeply concerned about this aspect.

4. The Practice : Gram Pravas is a new and novel experiment made by the University and has been quite successful. This program includes : i. going to villages periodically and interacting with village folks, -men, women and children. ii. learning from them their traditional skills iii. transferring to them the latest knowledge and technology iv. collecting first hand information of the status of execution of the Government's Welfare schemes; v. enquiring about their well being and extending to them all possible help for solving their problems. Each Participating student has to submit a report to his course coordinator after every Gram Pravas, which has to be reviewed by the course-coordinator and a subject expert for advising the students to improve their functioning in the next Gram Pravas. At the end of the semester, the student may have to undergo a Viva-voce test for evaluation. Course content of a particular Gram Pravas has to be designed on the basis of the level of the student and also the main course he is pursuing. To start with, we have made it compulsory for Ph.D. Course Work students. Slowly this practice is to be made compulsory for all streams of the students.

5. Evidence of Success: Initially, the Gram Pravas program was introduced with a pinch of hesitation regarding interest of the students in this program. To our surprise, the students both girls and boys successfully completed all the twelve Gram Pravas programs designed for them for their one semester course and came out with excellent reports fully illustrated with photographs and audio recorded dialogues. Their reactions to what they saw in the villages show the depth of their concern and their sensitiveness

6. Problems Encountered and Resources Required: Cooperation from the Govt. machinery is one point that may immensely enhance the quality of the Gram Pravas programmes. This may come in the form of transport facility and

participation of the Govt. officials and workers of the village level. Lack of toilets and bathroom facilities in the villages and the village schools was one of the major problems faced by the students, particularly girls.

7. Notes :

- i. It is recommended that Gram Pravas programmes be made compulsory for all teaching institutions at all levels in one form or the other.
- ii. Nehru Gram Bharati Vishwavidyalaya may be promoted as a nodal agency for promotion of the Gram Pravas Programme.
- iii. All Adarsh Grams adopted by Sansads and Vidhayaks must be covered by Gram Pravas programme of the Universities.

Annexure-2

Checklist for preparation of Gram Pravas FINAL PROJECT REPORT FOR COMPLETION OF Ph.D. COURSE WORK TO BE SUBMITTED BY EACH AND EVERY Ph.D. SCHOLAR

Gram Pravas (Research in Action & Action Research) of minimum 3 villages visited by Ph.D. Scholar vis a vis his/her own village or a nearby village if resident of an urban area.

- I. The essential purpose is to examine in the field in participatory mode the need-base of the households living in villages as currently and as aspired for completion in future 5-10 years.
- II. In view of the above, the derivative purpose is to examine the outcome of schemes & programs implemented by the government at the centre & state levels in rural areas over time Their efficiency and shortcomings in achieving the aims.
- III. The related purpose is to examine the benefits that the households received & improved their livelihood vis a vis the future expectations.
- IV. The other questions include whether workers migrate from village & if yes, under what conditions? How to examine and report it in terms of numerical indicators Keeping in mind the above, the university proposes the following study contents:
 - (i) What is the village? What is the rural zone?
 - (ii) Rural-urban links: The one in question vis a vis the ideal one.
 - (iii) Physical infrastructure in villages (like roads, electricity, water supply, public ponds, grazing areas, animal husbandry facilities etc.).
 - (iv) Public institutions in village like Panchayat, Primary school, Primary health centre, Post-office, Banks, Internet café's and internet connectivity etc.
 - (v) Public utilities & law and order: Its efficiency, loopholes etc.
 - (vi) Resource mapping of the village (like Agri/Horticulture, crop areas, water bodies, plantations), specialized facilities, expert's availability.....

- (vii) Social mapping (including social relations, culture, rituals, on social homogeneity etc.....).
- (viii) Social system (by caste, community, gender), complementary professions.
- (ix) Demographic mapping (by birth, death, literacy, marriage, profession....).
- (x) Actual living & expectations of people in village vis a vis their sustainability
- (xi) Status of elderly people and their care regular check up by doctor's, public and private sector dispensaries etc.
- (xii) Overall village outcome (transformation, sense of happy rural life etc...).

Paper - IV(Elective)
ADVANCES IN PHYSICS

Total Units: 05

Total Credit-04

Unit -I: Quantum Mechanics and Statistical Physics

Schrodinger Equation and its application in One dimensional and three dimensional, scattering. Partial wave method, the Born approximation. Time- independent and Time- dependent perturbation theory. WKB approximation. Symmetry in Quantum Mechanics, Identical particles and spin. Angular momentum operator, Elementary introduction to relativistic quantum mechanics: the Klein Gordon and Dirac equations. Introduction to second quantization; Quantum field theory: quantization of scalar field and Dirac field. Micro and macro states, Ensembles, Partition functions, BE Condensation, FD condensation, Landau theory for phase transition, Ising model: transfer matrix method; Onsager solution of 2-dimensional Ising model. Non-equilibrium statistical Mechanics: Response function and susceptibility; Fluctuation- dissipation theorem; irreversibility and the master equation; Fokker- Planck and diffusion equations.

Unit-II: Non-linear optics

Non-linear optics: Introduction and Background Material, Nonlinear Frequency Mixing, Non-linear susceptibilities of materials, symmetries, phase matching, second harmonic and sum frequency generation.

Optical coherence: The mutual coherence function, Van Cittert-Zernike theorem,

Hanbury Brown-Twiss effect, Second order coherence for thermal and coherent light.

Quantum electromagnetic field: Quantization of the electromagnetic field, Fock basis expansion, coherent state expansion, diagonal representation, Phase-space probability densities (P-, W-, and Q-representations). Ordering of operators, Non-classical states of radiation with examples. Photon antibunching.

Beam splitter and single-photon interference, The Mach-Zehnder interferometer, Two-photon interference and the HongOu-Mandel effect. Squeezing and generation of squeezed states. Elementary concept of entanglement and its applications.

Unit- III: Atmospheric Physics

Introduction to Earth's Atmosphere:

Atmospheric layers, Atmospheric constituents, Green house gases and their impacts on climate and human life.

Aerosols: Atmospheric aerosols: types and sources, direct and indirect effects of aerosol, aerosol

radioactive forcing and its climatic implication.

Ozone: Temporal and spatial distribution of ozone, ozone hole and its impact on climate and

human life.

Ionosphere: Structure and formation of ionosphere, ionospheric variability and irregularities

(Plasma bubbles, Spread-F, Sporadic E), equatorial ionospheric anomaly (EIA), ionospheric

Scintillations and consequences, Techniques to probe ionosphere: VLF, VHF, IONOSONDE,

GPS, radio occultation techniques

Space weather: Introduction to Space weather events and their impacts on Magnetosphere-

Thermosphere-ionosphere system, solar and geomagnetic activity, indices for measuring solar and geomagnetic activities, elementary idea about geomagnetic quiet and disturbed days.

Unit- IV: Nuclear and Particle Physics

Nuclear properties, Alpha, beta and gamma decays; Nuclear fission and fusion processes, Production of nuclear energy and working of a reactor. Nuclear forces, Models and reactions: Rutherford scattering; Nuclear fission and nuclear fusion, nuclear reactors, Heavy-ion reactions, Resonant and non-resonant reactions; Energy production and nuclear reactions in stars viz. Hydrogen burning, Helium burning, Particle accelerators and detectors, Fundamental forces and particles, symmetries, Quarks and leptons; Properties of mesons and baryons; Quark model, concept of color charge.

Unit- V: Numerical & Experimental methods and techniques:

1. Numerical Methods and Techniques:

(i)statistical Techniques: Mathematical tools for analysis, statistical data treatment and evaluation, Probability and Probability distributions, Sampling and

sampling designs, Data analysis, Testing of hypothesis, statistical test and analysis, Data in interpretation, multivariate analysis, Model building.

(ii) Analytical and Numerical techniques: Mean deviation, Root mean square deviation, Histogram, Variance, Regression, List square fitting

(iii) Statistical and graphical packages: MS Excel, MATLAB, Origin

2. Experimental methods and techniques: X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission electron microscopy (TEM), Ultra violet visible (UV) spectroscopy, Photoluminescence, Fourier Transform Infrared (FTIR), Vibration sample magnetometry (VSM).

References:

1. L. Mandel and E. Wolf, Optical coherence and quantum optics.
2. Lasers and Non-Linear Optics, B. B. Laud; New Age International, New Delhi, 1991.
3. C. C. Gerry, P. L. Knight, Introductory Quantum Optics.
4. G. S. Agarwal, Quantum Optics.
5. Nonlinear Optics, R.W. Boyd, Academic press, Elsevier, 2008.
6. Essentials of Lasers and Non-Linear Optics: Baruah; Pragati Prakashan; 2000.
7. M. A. Preston and R. K. Bhaduri, (1982), Structure of the Nucleus, Addison Wesley.
8. M. K. Pal, (1982), Theory of Nuclear Structure, East-west Press.
9. W. E. Burcham and M. Jobs, (1998), Nuclear and Particle Physics, AddisonWesley.
10. B. Povh, K. Rith, C. Scholz, F. Zetsche, (1995) Particles and Nuclei, Springer.
11. Rolfs and Rodney, Cauldrons in Cosmos: Nuclear Astrophysics, Chicago University Press.

Paper - IV(Elective) **ADVANCES IN CHEMISTRY**

Unit-I:

- (a) Electrochemistry and Electroanalytical Techniques, Advanced Topics in Kinetics and Thermodynamics, Radiation and Photochemistry.
- (b) MO treatment of bonding: Molecular orbital treatment of bonding in hydrazoic acid/hydrazide ion, Cu_2O , $\text{C}_n\text{O}_n^{2-}$, $\text{Fe}(\text{C}_5\text{H}_5)_2$, $\text{Cr}(\text{C}_6\text{H}_6)_2$, borane and metal clusters.

Unit-II:

- (a) Homogeneous catalysis by transition metal complexes: Hydrogenation of olefin, asymmetric hydrogenation, hydrosilation and hydroboration reactions. Hydroformylation of unsaturated hydrocarbons. Zeigler-Natta polymerization-mechanism.
- (b) Medicinal Chemistry: Potentiality of metal complexes as antihypertensive and anticancer agents. Metal complexes as Insulin adjuvant-probable mechanism. Bioinorganic chemistry of Pt-anticancer drugs: how they work? Chelation therapy in Alzheimer disease.

Unit-III:

- (a) Green Chemistry: Principals of Green Chemistry, atom economy, less hazardous chemical synthesis, waste prevention and minimization of waste generation, design for energy efficiency, use of enable feed stock and reduction of derivatives, green catalysis, applications of nanotechnology in green chemistry.
- (b) The Disconnection Approach. Basic principles, synthons, functional group interconversions. Order of events in organic synthesis. One group C-X disconnections and two group C-X disconnections.

Unit-IV:

Instrumental techniques: Basic principles and applications of instrumental techniques: Cyclic voltammetry, Gas chromatography, HPLC, IR, UV-Vis, ESR, ¹H/¹³C-NMR, Mossbauer, TG/DTA/DSC, SEM TEM, and XRD.

Unit-V:

Conjoint Spectroscopy Problems: Application of UV, IR, Raman, NMR, ESR and Mass spectrometry for elucidation of structure of organic and inorganic compounds.

Reading materials suggested:

Students are expected to consult standard books, monographs and research journals for the proposed course.

Paper - IV(Elective) ADVANCES IN MATHEMATICS

Unit-1

Mechanics in Fluid Media: Continuum Mechanics, Basic Laws, Continuum Hypothesis for Fluid, Role of Fluid Viscosity, different Non-Newtonian fluid Models & Applications, Stokes' hypothesis on stress and strain relations, Homogeneous & isotropic fluid medium, Navier-stokes equations, significance of reynolds number on flows, some exact solutions of Navier-stokes equation, approximate equation for slow motion, Stokes solution and paradox, Its

modifications by Oseen, high Reynolds number flows, Governing equations for electrically conducting fluid, Maxwell equations, Lorentz Force, MHD approximations, Magnetic Induction equation.

Unit 2

Inventory Control: Dynamic and Probabilistic Models, Interval Mathematics & Interval ranking, Soft computing methods for optimization, Optimization by MATHEMATICA, MATLAB and LINGO

Unit 3

Fundamental Concepts: Analytic Functions, C-R equations, Cauchy's Theorems, Cauchy's Integral Formula, Applications of Cauchy's Integral Formula, Liouville's Theorems, Taylor's Theorem, Laurent Theorem, Cauchy Residue theorem, Contour Integral, Zeros, Holomorphic functions, Rauch's Theorem, Counting of Zeros & Poles

Unit 4

Application of maximum modulus principle Jensen's formula

Applications of maximum modulus, Principle of Jensen's formula; Jensen's Formula, Picard Borel Theorem, Borel Caratheodary theorem, Hadamard three circle theorem, Effect of small derivatives, Nevanlinna Theory.

Unit 5

Approximation theory of normed spaces, B^* Algebra, Spectral theory of linear operators in normed linear space; spectral properties compact operations, unbounded operators and its applications, numerical range of bounded linear operations. Geometric structure on normed linear space; Strict convexity, Uniform Convexity

Recommended Books:

1. C.R. Kothari, Research Methodology: Methods and Techniques, New Age International (P) Ltd., New Delhi, 2010.
2. Lokesh Kaul, Methodology of Educational Research, Vikas Publishing House, 1984.
3. Ranjit Kumar, Research Methodology: A step-by-step Guide for beginners, Sage Publications, 3rd Edition, 2011.
4. G.K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press, 2005.
5. S.W. Yuan, Foundations of Fluid Mechanics, Prentice-Hall International, 1970.
6. H. Schlichting, Boundary Layer Theory, Springer, 2003.
7. P.K. Kundu & I.M. Cohen, Fluid mechanics, 3rd Ed. Academic Press, 2004.
8. F.S. Sherman, Viscous Flow, Mc Graw Hill International, 1990.

9. K. Muralidhar and G. Biswas, Advanced Engineering Fluid Mechanics, 2nd Ed. Alpha Science, 2005.
10. F.M. White, Viscous Fluid Flow, Mc Graw Hill International , 1991.
11. Serge Lang, Complex Analysis, IVth Ed. Springer Interantional Ed.
12. J.B. Conway, Functions of one complex Variable.
13. R.E. Green & S.G. Krantz, Function Theory of one Complex variables, American Mathematical Society.
14. L.V. Antflox, Complex Analysis, Mc Graw Hill.
15. B.V. Limaye, Functional Analysis, New Age International Publisher, 2017.
16. Edgar R. Lorch, Spectial Theory, Dover, 2018.
17. G. Bacman & L.N. Narlei, Functional Analysis, Dover, 2000.

Paper - IV(Elective)
ADVANCES IN ZOOLOGY

Credit 4

Unit 1: Instrumentation: Concept and Application

Centrifugation, Ultracentrifuge, Spectrophotometer, Electrophoresis, PCR, Microscopy, Chromatography, Flow meter, conductivity meter, solar radiation meter, dissolved oxygen meter, BOD, Incubator, water bath, Calorimeter

Unit II: Ecological models and applications in riverine ecosystems

Ecological concept, modeling and Application, Ecosystem: abiotic and biotic factors, Lotic and lentic ecosystem, Riverine community and its types: Plankton, nekton, benthos, Taxonomy
Biodiversity and its value, Status of biodiversity, conservation and management of biodiversity, Diversity, Evenness,
Indian rivers and its sources, River restoration, Heavy metal Ecosystem services, E-Flow, Ecological software: CANOCO, OMNIDIA, STATISTICA, PAST, SPSS

Unit III: Fisheries: Resource, management & application

Population of Fish Resource, and age structure
Fish biodiversity and distribution in various river systems of India
Impact of Heavy metals on fish resource
Fish Biology: length-weight, food and feeding, reproductive Biology
Fish stock assessment, soft wares *viz* TRUSS, FiSAT, CAPS

Unit IV: Biotechnology & Biochemistry

Structure of nucleic acids, super coiling, genetic & Non-genetic RNA
DNA replication, DNA repair (excision repair, mismatch repair and SOS repair)
Restriction enzymes in cloning, techniques used in recombinant DNA technology
and its application, DNA fingerprinting, Docking & Simulation

Unit V: Cell Biology & Neurobiology

Cells in culture: Requirements for cell culture
Aseptic technique, primary culture, organotypic cultures.
Immunology: Concept of vaccination, Immunotherapy, Bioinformatics

Suggested Readings:

1. Odum: Fundamental of Ecology (1971, W.B. Saunders)
2. Odum and Barrett: Fundamentals of Ecology (5th ed 2005 EWP)
3. Cunningham and Saigo: Environmental Science (5th Ed. 1999, McGraw Hill)
4. Willimer, Stone and Johnston: Environmental Physiology (2000, Blackwell Sci. Oxford 4K)
5. Ausubel et al.: Short Protocols in Molecular Biology. (2002, Wiley Pub.)
6. Glick and Pasternak: Molecular Biotechnology. (2003, ASM Press)
7. Kracher: Molecular Biology - A Practical Approach (1995, Academic Press)
8. Krenzer and Massey: Recombinant DNA and Biotechnology (2000, ASM Press)
9. Meyers (Ed.). Molecular biology and biotechnology. (1995, VCH Publishers)
10. Smith: Biotechnology (5th ed 2009, Cambridge University Press)
11. Rana: Bio-techniques: Theory & Practice (2007, Rastogi publications)
12. Barrett: Text Book of Immunology (1988, Mosloy)
13. Benjamin et al: Immunology – A Short Course (2003, Wiley-Liss)
14. Prakash Singh, Bisen, Anjana Sharma: Introduction to instrumentation in life Sciences
15. S Chand & Company Ltd: Biological Instrumentation and methodology (Tools and Techniques)
16. Karl F. Lagler, John E. Bardach, Robert R. Miller, Dora R. May Passino, Ichthyology (1991), 2nd Edition, Wiley & Sons, New York
17. S. S. Khanna: An Introduction to fishes, Silver Line Publications, Prayagraj, UP

Paper - IV(Elective)
ADVANCES IN BOTANY

Unit-I

Plant Cell Culture, Plant Transformation Technology & its Applications:

Basics of Tumor formation, Hairy root. Mechanism of DNA transfer, role of Virulence gene. Features of Ti & Ri Plasmid, Use of Ti & Ri as vectors, Binary vectors. Use of 35s & other promoters, genetic markers methods of nuclear transformation, viral vectors & their applications. Multiple gene transfers: vector less or direct DNA transfer. Use of reporter gene. Particle bombardment, electroporation, Microinjection. Transformation of monocots. Transgene stability & gene silencing in Plant transformation. Applications of Plant Transformation for Productivity & performance Herbicide resistance like atrazine. Insect resistance Bt gene, non Bt like protease inhibitors, Virus resistance, disease resistance, antibiotic Stress, post-harvest losses, long shelf life of fruits & flowers. Chloroplast transformation. Metabolic engineering & Industrial products.

Unit II

Applied Microbiology and Microbial Ecology:

Fungi Isolation, Pure culture, Staining and identification, Soil Enzymes origin and range of enzymes in soil, methods of measurement and extraction of soil enzymes, interactions between agrochemical and soil enzymes. Recent advances in biological Nitrogen fixation. Microbial Bio-fertilizers. Epidemiology of plant diseases. Biological control of soil borne plant pathogen. New Directions and Importance of Microbial Ecology. Ectomycorrhiza, Arbuscular mycorrhizal fungi (AM fungi), Mycorrhizal fungi Applications.

Unit III

Physiology of Stress in Plants: Stress due to water – Plants and water, chemical & potential gradients, transpiration, stomatal apparatus, mechanism of opening & closing, antitranspirants, Effect of water stress on accumulation of proline and betaines and their possible role in osmotic adjustment under such conditions. Drought tolerance/resistance mechanism, screening methods for water stress tolerant varieties. Availability of soil water & determination of soil water potential, Mechanism of plant resistance to water logging/hypoxia.

Unit IV:

Biotechnological Application of Hazardous Waste Management and Management of Resources: Need for management of resources. Role of environmental biotechnology in management of resources. Reclamation of wasteland, biomass production. Biogas and biofuel production. Development of environmentally friendly processes such as integrated waste management.

Unit V:

Plant Taxonomy and its Molecular Approach: Method I – Morphology, anatomy, development. Discussion: character evolution. Chromosome counts. Method II – pollen, secondary chemistry, cytotaxonomy Discussion: chromosomal evolution, polyploidy. Chromosome counts, cont'd? Plant Systematics literature; End of taxonomy review (herbarium). Method III – DNA-Discussion: appropriate techniques DNA extraction. Phylogenetic inference I Discussion: inferring phylogenies PCR, gel electrophoresis. Phylogenetic inference II Discussion: evaluating support for phylogenies. Developing phylogenies. Phylogenetic inference III Discussion: comparing multiple data sets. Developing phylogenies.

Suggested Readings:

1. An introduction to Plant Tissue Culture 2nd Edn. Razdan, M.K., Science Publishers, USA.
2. Textbook of plant biotechnology, Chawla P.K. 2002, Oxford & IBH, New Delhi.
3. Bhojwani, S. S. and dM. K. Razdan 1996. Plant Tissue Culture: Theory and Practice, Elsevier Publ.
4. Chrispeels, M. J. 2002. Plant Tissue Culture: Genetical Aspects. Jones and Bortlett Publishers, International.
5. Chopra V. L. et al 1999. Applied Plant biotechnology. Science Publishers Inc.
6. Verpoorte, R. and A. W. Alfermann (Eds) 2000. Metabolic Engineering of plant secondary metabolism, lower Academic Publisher.
7. Kuchler, R. J., Biochemical Methods in cell culture and Virology, Dowden, Hutchinson and Ross, Inc. Strausberg, USA, 1977.
8. Morgan, S. I. Animal cell culture, 1993, Bio Scientific Publishers Ltd, Oxford.
9. Freshney, R. I. Culture of Animal cells: A Manual of Basic Technique, 1994, John Wiley and Sons Inc. Publication, USA.
10. Butler, M. Mammalian, cell Biotechnology. A Practical Approach (1991), IRL Press. Oxford.
11. Jenni P.Mather and David Barnes, eds; Animal cell culture Methods, Methods in cell Biology, vol.57. Academic Press.
12. Cell Culture: Methods in enzymology, Vol-58, Academic Press 1979 or recent. Soil Enzymes by R. G. Burns.
13. Chemistry and Biochemistry of Biological Nitrogen Fixation by J. R. Postgate. Plenum Press.
14. Biofertilizers by L. L. Somani and others. Scientific Publishers, Jodhpur.
15. Plant Pathology by J. C. Walker.

16. Plant Diseases by R. S. Singh.
17. Microbial Ecology by J. M. Lynch.
18. Bergey's Manual of Systematic Bacteriology Volume I. Springer.
19. Annual Reviews in Microbiology Volumes 46 & 49 by L. N. Ornston, A. Balows and E. P. Greenberg (eds).Academic Press.
20. Microbes in Extreme Environments by D. J. Kushner.
21. Anaerobes by Shapton. Academic Press.
22. Microbiological Aspects.of Anaerobic Digestion -- A Laboratory Manual by D. R. Ranade and S. V. Gadre (eds) Agharkar Research Institute, Pune.
23. Geomicrobiology by H. L. Ehrlich Basra, A.S. & Basra, R.K. 1997. Mechanisms of environmental stress resistance in plants, Harwood Academic, Publishers, The Netherlands.
24. Chopra, V.L. & Paroda, R.S. 1988. Approaches for incorporating drought and salinity resistance in crop plants, Oxford & IBH Publishing Co. Pvt. Ltd., ND.
25. Gupta, U.S. 1985. Physiological aspects of dryland farming, Oxford & IBH Journal of Bioscience,Special issue: Cellular Stress Response, 1998.23(4):Oct., The Indian Academy of Sciences, Bangalore.
26. Kramer, P.J. 1983. Water relations of plants, Academic Press Inc., NY.
27. Nilsen, L. & Orcutt, 1998. Physiology of plants under stress : Abiotic factor.
28. Paleg, L.G. & Aspinall, D. 1981. Physiology and biochemistry of drought resistance in plants, Academic Press, NY.
29. Singh, Randhir & Sawhney, S.K. 1988. Advances in frontier areas of plant biochemistry, Prentice-Hall of India Pvt. Ltd., New Delhi.
30. Smallwood, M.F., Colbert, C.M. and Bowles, D.J. 1999. Plant responses to environmental stress, BIOS Scientific Publishers Ltd., USA.
31. Taiz, & Zeiger, 1998. Plant Physiology, Sinauer Associates.
32. Treshow, M. 1970. Environment and plant response, Mc Grow Hill, N.
33. Biotreatment Systems , Volume II; D.L. Wise.
34. Advances in Biotechnological Process ; Mizrahi & Wezel.
35. Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications. McGraw-Hill 2nd edition (July 25, 2000) ISBN: 0072345535.
36. Raina M. Maier, Ian L. Pepper, Charles P. Gerba. Environmental Microbiology. Publisher: Academic Press; (February 23, 2000).
37. Martin Alexander. Biodegradation and Bioremediation. Academic Press; 2nd edition (April 15, 1999) ISBN: 0120498618.
38. Gabriel Bitton (Author). Wastewater Microbiology, 2nd Edition. Wiley-Liss; 2nd edition (February 16, 1999) ISBN: 0471320471.
39. Milton Wainwright. An Introduction to Environmental Biotechnology. Kluwer Academic Publishers, Boston. Hardbound, ISBN 0-7923-8569-1.July 1999, 192.

40. M.N.V. Prasad, Kazimierz Strzalka. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. Kluwer Academic Publishers, Dordrecht Hardbound, ISBN 1-4020-0468-0. February 2002, 460 pp.
41. Biotechnology for Solving Agricultural Problems; Danforth & Bakst.
42. Introduction to Environmental Microbiology; R. Mitchell.
43. Davis, PH. and Y.H. Heywood. 1965. Principles of Angiosperm Taxonomy.
44. Oliver & Boyd. •Grant, W.F. 1984. Plant Biosystematics. Acad. Press. Newyork.
45. Grooves, M.J. 2006. Pharmaceutical Biotechnology. Taylor and Francis, London.
46. Heslop-Harrison. 1953. New concepts in Flowering Plant Taxonomy. London.
47. Judd. W.S. et al . 2002. Plant systematics A Phylogenetic approach 2nd. Edn. Sinauer associates Inc. Publishers. Sunderland, Massachusetts, USA.
47. Kubitzki, K. 1977 Flowering Plants: Evolution and Classification of High Categories Springer Verlag, Berlin, Heidelberg. Germany.
48. Mahendra Rai and Maria Carpinella 2006 Naturally Occurring Bioactive Compounds. 3 Elsevier.
49. Nair, P.K.K. (ed.) 1976. Aspects of Plant Sciences Vol. I Today and Tomorrows printers and publishers, New Delhi.
50. Simpson, M.G.2006. Plant systematics. Elsevier Academic Press, U.S.A.
51. Singh, G. 2004. Plant systematics - Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
52. Sivarajan, V.V. 1991. Introduction to the principles of taxonomy, Oxford and IBH Pub. Co., New Delhi.
53. Soltis, D.E and Doyle, J.J. 1992. Molecular systematics of Plants. Chapman and Hall. New York, London.
54. Stace C. A. 1991-Plant Taxonomy and Biosystematics. Edward Arnold. 2nd ed.
55. Stebbins, G.L. 1970. Variation and Evolution in Plants. Oxford Book Co.
56. Stebbins. G.L. 1970. Variation and Evolution in Plants.. Progress during the last twenty years.
57. M.K. Hecht and W.E.. Sture (eds). In Evolution and Genetics. North. Holland Pub. Co. Amsterdam.
58. Stebbins, G.L. 1971. Chromosomal Evolution in Higher Plants. Addison Wesley Pub. Co. London.
59. Steuassy, T.F. 1990. Plant taxonomy: The Systematic Evaluation of Comparative Data. Bishen Singh Mahendra Pal Singh, New Connaught Place, India.
60. Walton, N.J and Brown, D.E. 1999. Chemicals from Plants: Prospectives on plant secondary products. Imperial College Press and World scientific publishing company Pvt. Ltd. London.

61. Samuel, D.J and Arlene, E.L 2009. Plant systematics. 2nd Edn. McGraw M company New York.
62. Surindar Kumar Guptha 2009. Biology and breeding of crucifers. CRA press.
