UTTARANCHAL
UNIVERSITY

UTTARANCHALUNIVERSITY

ArcadiaGrant,P.O.Chandanwari, Premnagar,Dehradun, Uttarakhand-

248007,INDIA

Detailed Course Structure & Syllabus

of

Pre Ph.D. (Biotechnology)

Course Work

(As per CBCS system)

W.E.F Session 2022-23

Course Structure of the Pre-Ph.D (Biotechnology) Course Work:
Applicable for Batch: 2022-23

SCHEME OF EXAMINATION

Ph.D(Biotechnology)
(Effective from Academic Year 2022-23)

Under Choice Based Credit System (CBCS)

Course Structure of the Pre-Ph.D (Biotechnology) Course Work:
Applicable for Batch: 2022-23

Scheme of Pre-Ph.D. Course Work

S.No	Course Code	Subject	Credits	Evaluation – Scheme							
				Period			Sessional			Examination	
				L	T	P	CT- I	CT- II	Total	ESE	Sub. Total
Courses											
1.	RM-101	Research Methodology	4	4	0	0	20	20	40	60	100
2.	RM-102	Computer & Stats Application in Research	2	2	0	0	20	20	40	60	100
3.	RPE-103	Research & Publication Ethics	2	2	0	0	20	20	40	60	100
4.	DSE-104	Discipline Specific Electives	3	3	0	0	20	20	40	60	100
5.	RS-105	Seminar Presentation	2	0	0	4	20	20	40	60	100
		Total	**13**	**11**	**0**	**4**	**100**	**100**	**200**	**300**	**500**

List of Electives (Biotechnology)

S. No.	Course Code	Course Name
1	**AR-104**	**Advanced Research &Instrumentation Techniques**
2	**BT-102 (1)**	**Advanced Bio- Analytical Techniques**
3	**BT-104 (2)**	**Plant Biotechnology**
4	**BT-104 (3)**	**Environmental Biotechnology**

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SYLLABUS

of

Ph.D(Biotechnology)

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RM-101	Credit	4
Year/Sem	1/1	L-T-P	4-0-0
Course Name	Research Methodology		

Objectives of the Course:

1. To Equip the Students with the Concept and Methodology of Research.
2. To provide knowledge about type of research, preparation of reports and thesis, designing of Research using Scientific Methods.

UNIT I (Total Topics- 7 and Hrs-12)

Introduction to Research: Definition, Nature and significance, Role and Objectives; Types of Research: exploratory, descriptive, experimental and diagnostic research, social and legal research and traditional, analytical, empirical & fundamental research, Doctrinal and non-doctrinal research methods; Various Research Designs; Scientific Research Process: Overview, Problem identification and formulation of research statement.

UNIT II(Total Topics- 7 and Hrs- 12)

Data Collection: sources, primary and secondary methods, significance of Primary and Secondary Data, questionnaire Vs. schedules; Data Processing: Editing, Coding Organization and Presentation; Attitude Measurement and scaling: Measurement Scales, Sources of Errors in Measurement, Techniques of Developing Measurement Tools, Classification and Testing (Reliability, Verification and Validity) Scales, Designing Questionnaires and Interviews.

UNIT- III (Total Topics- 5 and Hrs- 10)

Sampling, Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions: Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors, Concept of Permutation, Combination & Probability for research analysis.

UNIT-IV(Total Topics- 5 and Hrs- 10)

Interpretations and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Steps in Report Writing, Layout of Report and Precautions in Writing Research Reports. Limitations of RM: Ethics in Research, Philosophical Issues in Research.

CO1. Acquire in-depth knowledge of various fundamentals, theories and principles related to the research and apply the acquired knowledge in carrying out research studies in the area of interest.

CO2. Identify, formulate and critically investigate research problems by applying research-oriented knowledge and analyze relevant data to reach certain conclusions in the form of alternative solutions to these problems.

CO3. Apply the acquired knowledge and skills to develop minds to think out of the box while carrying out research operations to conclude something.

CO4. Apply parametric and non-parametric statistical tests to verify the developed hypothesis to suggest innovative solutions to the problem being investigated.

Reference Books

1. William G. Zikmund, "Business Research Methods", Orlando: Dryden Press.
2. C. William Emory and Cooper R. Donald, "Business Research Methods", Boston, Irwin.
3. Fred N Kerlinger, "Foundations of Behavioural Research", New Delhi: Surjeet Publications.
4. Naresh Malhotra, Marketing Research : An Applied Orientation, Pearson publication David Nachmias and ChavaNachmias, "Research Methods in the Social Sciences", New York: St.Marlia's Press.
5. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RM-102	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Computer & Stats Application in Research		

Objectives of the Course:

1. To appraise computational skills for research application.
2. To assess statistical method for research analysis.

UNIT I

Characteristics of Computers, Evolution of computers, computer memory, computer generations, Basic computer organization; System software, Application software, introduction to operating system, single user, multi-user, multi-tasking single tasking, application of computer for business and research, MS-windows, Linux .Application of Internet in research : INFLIBNET, Use of Internet, sights (DOAJ), Use of E Journals, Use of E library, use of EBSCO HOST online database of Academic Libraries. Subject/field specific tools on www.freeware.com

UNIT II

Computer Application in Research,. Basic concept of Computer, Use of Internet for Research Purpose: E-mail, WWW, Web browsing, technical skills, drawing inferences from data, Research publishing tools-MS Word, Adobe acrobat, Graphics tool-MS Excel, Presentation tool-MS Power, Data Analysis Software and Analysis Techniques point. Creating presentation and adding effects, Introduction to Data analysis software-SPSS: Definition, objectives and features, data analysis using SPSS.

UNIT- III

Statistical methods for research application in analysis of data,Measurement in Research , data interpretation, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), std deviation, Measures of Relationship, Simple Regression Analysis, Correlation and Regression, Partial Correlation.

UNIT-IV

Statistical Tools-Hypothesis and Hypothesis Testing: Parametric & Non-Parametric Tests, Important Parametric Tests ,Hypothesis Testing of Correlation Coefficients ,U Test, Chi Square Test, ,T-Test.Analysis of Variance (ANOVA) , The Basic Principle of ANOVA ,ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA .

Course Outcomes:

CO1. Acquire knowledge of concept of computer with application in Research.
CO2. Apply acquired knowledge of computer for presentation skills.
CO3. Acquire knowledge of statistical methods for Research.
CO4. Apply acquired knowledge to describe the inductive nature of quantitative data analysis.

Reference Books

1. C. R. Kothari, "Research Methodology: Methods and techniques", New Delhi: Vishwa Prakashan.
2. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, New York, Routledge Publication.
3.Jain, Satish: "Introduction to Computer Science and basic Programming." BPB Publications, New Delhi, 1990. • Rajaraman, V., "Fundamental of Computers", Prentice Hall of India, New Delhi, 1996.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RPE-103	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Research& Publication Ethics		

Objectives of the Course:
Its objectives to provide knowledge about ethics and code of research publication with concept of plagiarism.

UNIT I (Total Topics- 2 and Hrs-8)
1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

UNIT II(Total Topics- 5 and Hrs- 5)
1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

UNIT- III (Total Topics-7 and Hrs-7)
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

UNIT- IV (Total Topics-4and Hrs-4)

Practice

Open Access Publishing
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.

CO1. Recognize the basics of philosophy of science & ethics, research integrity, publication ethics and theories of research ethics.
CO2. Familiarize with important issues in research ethics, research integrity, scientific misconduct and misinterpretation of data.
CO3. Analyze the best practices for publications, publication ethics and identify the predatory publishers & journals.
CO4. Demonstrate &use plagiarism software tools, open-source software tools, citation databases and

research metrics.

CO5. Publish credible & scholarly publications in reputed peer-reviewed journals.

References-

Research and Publication Ethics, Dr Sumanta Dutta, Bharti Publications,2021
Research and Publication Ethics, Dr Santosh kumar Yadav, Anne Publications,2020

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	RS- 105	Credit	2
Year/Sem	1/1	L-T-P	0-0-4
Course Name	Seminar Presentation		

Objectives of the Course:
Main objective of this course is to develop presentation skills in the scholars and knowledge about review of literature so that they can review properly for utilisation in their research work.

Seminar Presentation-Candidate/Research Scholar has to go through the review of literature in the concerned field of research. Review of literature guidelines will be given by the concerned faculty/Dean of Department/School/College. Research Scholar has to prepare presentation on review of literature in the concerned field/ topic assigned by the department (DRC) periodically during course work. There will be minimum 3 presentations of review of literature during pre-Ph.D. course work.

- First presentation will be required in DRC/FRC for review of literature with concerned Department focus on area of research. It will be evaluated and assessment sheet will be sent from Department to Dean Research & Studies office.
- Similarly second presentation will be required by research scholar with extension of first presentation and more number of references would be added.

Internal & end term examination marks will be as per scheme. Each presentation is to be assessed by the department as per instructions from Dean-Research & Studies.

Final presentation would be required at the time of end term/sem. examination on proposed synopsis. General guidelines would be issued by Dean-Research for seminar presentation.

Course outcomes
CO1. Research Scholar would be able to develop & explore the review of literature in concerned area.
CO2. Analyze review of literature critically for finding the research gap.
CO3. Apply acquired knowledge in making systematic seminar presentations.
CO4. Apply acquired knowledge for improving development of all-round research.

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	AR-104	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**Advanced Research &Instrumentation Techniques**		

Objectives of the Course:

1. To learn & apply concept of Thermogravimetric techniques in research.
2. To provide knowledge about spectroscopic techniques for research.

UNIT I (Total Topics-12 and Hrs-12)

UV-Visible spectroscopy

Basic principle, Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, molar extinction coefficient, concept of chromospheres and auxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic, UV spectra of conjugated enes and enones, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fiesher rules for conjugate dienes and carbonyl compounds.

Infrared spectroscopy

Infra-red spectroscopy: Basic principle, Instrumentation Selection rules, fundamental modes of vibration, overtones, combination bands, Fermi resonance, Factors affecting IR spectra. Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric Interactions with molecules: absorption and scattering. Means of excitation (light sources), detection of the signal (heat differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR).Interpretation of IR spectra of aliphatic, aromatic hydrocarbons, amines, amides, carbonyl compounds etc

UNIT- II(Total Topics- 12 and Hrs-12)

NMR spectroscopy

Principle, Instrumentation, Factors affecting chemical shift, Uses of TMS equivalent and non-equivalent protons, chemical shifts, factors affecting chemical shifts, shielding of magnetic nuclei, deshielding, anisotropic effects in alkene, alkyne, aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange,Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

Thermal methods of analysis:

Thermal methods: Principle & application of Thermogravimatric analysis; TGA, DTA & DSG , DSC : Principle instrumentation and applications.

UNIT-III (Total Topics- 12 and Hrs- 12)

Microscopic Techniques: Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunneling microscopy (STM), Introduction & application of Bio analytical techniques

UNIT-IV (Total Topics- 12 and Hrs-12)

Physical instrumentation techniques: Physical Properties: Introduction, & applications of different physical Characteristics: Viscosity, optical activity & conductivity, Instrumentation: Viscometer, pH meter, Refractometer, Polarimeter.

CO-1: Inculcate knowledge about advanced techniques for physical parameters of materials.
CO-2: Apprcise UV visible&Spectroscopic techniques.
CO-3: Learn interpretation of data used in spectroscopy analysis.
CO-4: Learn principle and method of microscopic & thermogravimatric techniques for characterisation of material for research.

Reference Books:

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Practical NMR Spectroscopy, ML Martin, JJ Delpeach and GJ Martin, Heyden.
4. Fundamentals of Molecular Spectroscopy Colin N. Banwell and Elaine M. Mc Cash Tata McGraw Hill.
5. Introduction to NMR Spectroscopy: RJ Abraham, J Fischer and P Loftus, Wiley.
6. Spectroscopic Method in Organic Chemistry: DH Williams, I Fleming, Tata MacGraw Hill.
7. Instrumental Method of Analysis: Seventh Edition, Willard Merritt, Dean, Settle. CBS

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Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	**BT-102 (1)**	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**ADVANCED BIO- ANALYTICAL TECHNIQUES**		

Objectives of the Course:

1. Identify the principle, instrumentation of different bioanalytical techniques.
2. Acquire skills to analyze and interpret data obtained in analytical studies of biomolecules.
3. Appraise widespread applications of analytical techniques in lifesciences.

UNIT ICHROMATOGRAPHIC TECHNIQUES (Total Topics- 12 and Hrs- 10)

Chromatography - Principle and application. Types of chromatography - Adsorption chromatography, Partition chromatography, Gas chromatography, liquid chromatography, Paper & Thin layer chromatography, Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, HPLC (High Performance/Pressure Liquid chromatography).

UNIT IIELECTROPHORETIC TECHNIQUES (Total Topics- 8 and Hrs- 10)

Electrophoresis - General principle and application electrophoresis, Gel electrophoresis (Native, Denaturing & Reducing), Disc Gel electrophoresis, Slab Gel electrophoresis, Isoelectrofocussing (IEF), Isotachophoresis

UNIT- III CENTRIFUGATION TECHNIQUES (Total Topics- 12 and Hrs- 10)

Centrifugation: Basic principles. Common centrifuges used in laboratory (clinical, high speed & ultra-centrifuges). Sedimentation rate, Sedimentation coefficient. Types of rotors. Types of centrifugation: Preparative, differential & density gradient.

UNIT-IV MICROSCPIC AND SPECTROSCOPIC METHODS (Total Topics-15 and Hrs-10)

Principle of Microscopy. Types of microscopy- Light, phase contrast, Fluorescence and Confocal microscopy, Scanning and Transmission Electron microscopy. Spectroscopic methods : principle and applications of UV-visible, IR, NMR, ESR. X-ray crystallography. Mass Spectrophotometry, MALDI-TOF, ESI (Electron spray ionization).

UNIT-VMOLECULAR TECHNIQUES (Total Topics- 10 and Hrs- 10)

Blotting techniques- Southern, Western and Northern; CRISPER Technology, RAPD, RFLP, AFLP, SSR markers. Gene sequencing methods.

Course Outcomes (COs)

1. Exhibit profound understanding of concept and principle of various bioanalytical techniques.
2. Demonstrate conceptual knowledge and technical skills pertaining to types and process of electrophoresis, chromatography, centrifugation, microscopic and spectroscopic techniques.
3. Acquire ability to identify, analyze and apply bioanalytical techniques to address problem related to environment, health & medicine and scientific research.
4. Inculcate scientific temperament to appraise recent technological development and their respective application.

Reference Books

1. Sharma, V.K.: Techniques in Microscopy and Cell Biology Tata McGraw Hill, 1991.
2. Alberts et al.: Molecular Biology of the cell (2nd ed.), Garland, 1989.
3. Biochemical Technique: Theory & Practical J.F. Robyt& B.J. White $ 30.95. Waveland Press, Inc.
4. Biophysical Chemistry. Upadhyay, Upadhyay and Nath

5. Wilson & Walker: Practical Biochemistry (4th ed) University of Hertfordshire Cambridge University Press

Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	**BT-104 (2)**	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**PLANT BIOTECHNOLOGY**		

Objectives of the Course:

1. Identify the underlying principle of plant tissue culture and its different types.
2. Comprehend tools and techniques implement in production of transgenic varieties.
3. Appraise widespread applications of plant biotechnology.

UNIT I (Total Topics- 13 and Hrs- 10)

Early attempts in tissue culture of plants. Concept of totipotency. Sterilization procedures. Design of laboratory and commercial tissue culture facility. Media for *in vitro* culture; Types of media – Solid, liquid and commercial pre-packed media; Media composition – Macronutrients, Micronutrients and growth regulators; Preparation of media; Selection of suitable explants.

UNIT II(Total Topics-15 and Hrs- 10)

Direct and indirect organogenesis. Callus culture - initiation and maintenance of callus. Haploid culture. somatic embryogenesis and synthetic seed production. Haploid culture: Androgenesis & Gynogenesis. Embryo culture & Embryo rescue, Protoplast culture & protoplast fusion – Cybrids, Symmetric &Asymmetric hybrid. Somatic embryogenesis andSomaclonal variation, cryo-preservation.

UNIT- III (Total Topics- 15 and Hrs- 10)

Components of plant genetic engineering..Ti& Ri plasmids, Binary vector, expression vector, cointegrated vector. Transformation: Vector mediated and vector less DNA transfer (Particle bombardment, electroporation, microinjection) in plants. Application of plant cell & tissue culture: Transgenics, secondary metabolites, Industrial enzyme, edible vaccine.

UNIT-IV (Total Topics- 10 and Hrs-10)

Applications of Plant Genetic Engineering – crop improvement, herbicide resistance, insect resistance, virus resistance, abiotic stress tolerant plants, BT gene, Application of Plant Transformation for productivity and performance, Study of biopesticides used in agriculture.

Course outcome

CO1- Identify the principle and procedure involved in micropropagation technique and types of tissue culture.
CO2-Exhibit skill pertaining to implementation of biotechnological tools in plant and agriculture science
CO3- Comprehend tool sand techniques of transgenic technology
CO4- Analyse widespread applications of plant biotechnology in medicine, environment conservation and production of transgenic plant varieties.

Reference Books

1. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.
2. Raven, P.H., Johnson, G.B.,Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.
3. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing

House.
4. H.S.Chawla, Plant Biotechnology, S.Chand Publications.
5. Slater, A., Scott, N.W. & Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.

Programme Name	**Pre-Ph.D. Course Work**	Programme Code	23-
Course Code	**BT-104 (3)**	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	**ENVIRONMENTAL BIOTECHNOLOGY**		

Objectives of the Course:

1. Identify implementation of biotechnological approachesin conservation of environment.
2. Comprehend tools and techniques implementedto achieve treatment of polluted water and industrial waste.
3. Appraise widespread applications of environmental biotechnology.

UNIT I Environmental Biotechnology(Total Topics- 13 and Hrs- 10)

Concept, Definition and explanation for various terms components of environment Air pollution and its control through Biotechnology (deodorization, reduction in CO2 emission, bioscrubbers, biobeds, biofilters etc). Water pollution and its controls: Sources of water pollution. Environmental Impact Assessment (EIA) Need of EIA; Scope and objectives; Types of environmental impacts; Steps involved in conducting the EIA Studies.

UNIT IIENVIRONMENTAL MONITORING AND SAMPLE ANALYSIS (Total Topics- 12 and Hrs- 10)

Sampling of air and water pollutants; Monitoring techniques and methodology, pH, Dissolved Oxygen (DO); Chemical oxygen demand (COD); Biological Oxygen Demand (BOD); Speculation of metals, monitoring & analysis of CO, NO2, CO2, SO2 ; Pesticide residue; Phenols and petrochemicals. Instruments used in chemical analysis of environmental samples.

UNIT- III WASTE MANAGEMENT AND TREATMENT(Total Topics-16 and Hrs-10)

Effluent treatment systems Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Biological treatments - aerobic versus anaerobic treatments. Biofilms in treatment of waste water; Bioreactors for waste water treatments; Reactors types and design. Solid waste management of municipal and biomedical waste Basic aspects of solid waste management; Aerobic and anaerobic treatments of solid wastes; Composting; Vermiculture; Biogas generation; Biomedical wastes, Types of biomedical wastes; Hazards caused by biomedical wastes; Treatment strategies for biomedical wastes.

UNIT-IV BIOTRANSFORMATION AND BIODEGRADATION (Total Topics-12 and Hrs-10)

In situ and Ex situ bioremediation. Biodegradation; Factors affecting process of biodegradation; Methods in determining biodegradability (Hydrocarbon degradation); Contaminant availability for biodegradation. Xenobiotics; Use of microbes (bacteria and fungi) and plants in biodegradation and Biotransformation. Heavy metal and oil spill bioremediation Sources of heavy metal pollution.

Course outcome

CO1- Comprehend the concept of environment biotechnology and implementation of same foe environment impact assessment.
CO2-Exhibit skill pertaining to implementation of tools and techniques for environment monitoring.
CO3- Analyse different approaches utilized for waste management and treatment and application of same in eco friendly manner.
CO4- Identify the potential of microbes and fungi as potential candidate for bioremediation

Reference Books

1. Environmental Biotechnology, T.R.Srinivas, [1st Ed. ed.] New Age International Pvt Ltd Publishers (2008)
2. Environmental Biotechnology, R.A.Sharma, Pointer Publishers (2007)
3. Environmental Biotechnology: Texbook by Indu Shekhar Thakur