

Dr. Homi Bhabha State University, Mumbai.

Proposed structure for Two Year PG Program (M.Sc.) Degree

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC , VEC , IKS	OJT/ FF	Cum. Cr/Sem	Degree/Cum. Cr.
		Mandatory	Elective							
6.0	I	DSC1-1 Biochemistry and Metabolism (4+2)	DSE1- 1 Biochemical and Biophysical Techniques (4+2)	Research Methodology(4)	-	-	-	-	22	44 PG Diploma in Discipline
		DSC1-2 Immunology (4+2)								
	II	DSC1-3 Bioprocess Technology (4+2)	DSE1-2 IPR, Biosafety, GMO and Environment (4+2)	-	-	-	-	OJT/FP (4)	22	
		DSC1-4 Molecular Biology (4+2)								
6.5	III	DSC1-5 PTC & ATC (4+2)	DSE1-3 Biostatistics & Mathematical modeling of Bioprocesses (4+2) OR Software Tools for Research & Scientific Commun. (4+2)					RP (4)	22	88 PG Degree in Discipline
		DCS1-6 Medical Microbiology & Clinical Research (4+2)								
	IV	DSC-7 Bioinformatics (4+2)	DSE1-4 Develop. Biology (4+2) Or Nanotech (4+2)					RP (6)	22	
		DSC-8 Applied Biotech (4)								
	Cum Cr.	46	24	04	-	-	-	14	88	

Exit Option: Award of PG Diploma in Discipline with 44 credits OR Continue with Discipline.

Syllabus for Department of Biotechnology (M.Sc. Sem I)

	Course Code: MSBTDC101T	Course Title: Biochemistry and Metabolism	
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Biochemistry Starch and Glycogen. Cellulose, Chitin, Glycosaminoglycans- Heparin, Chondroitin sulphate, Hyaluronic acid Glycoproteins & Glycolipids, Acidic sugars – ascorbic, glucuronic Opioid peptides- Enkephalins and Endorphins, Lipids- Lipoproteins, Vitamins and co-enzymes -significance in metabolism, Prostaglandins		15 Hrs
UNIT II	Physiological Biochemistry Regulation of acid-base balance, types and functions of acid-base buffers, clinical abnormalities associated with acid-base imbalance. Water and Mineral metabolism		15 Hrs
UNIT III	Metabolism HMP, glycogenesis and glycogenolysis. Control of glycogen metabolism: Allosteric control, covalent modification of enzymes by cyclic cascades, maintenance of blood glucose levels. Lipid metabolism: Biosynthesis of fatty acids (saturated, monounsaturated, polyunsaturated), triglycerides and phospholipids. FAS Complex, regulation of fatty acid metabolism. Catabolism of Amino acids: phenylalanine, tyrosine. Degradation of purine nucleotides. Salvage pathway of purines. Hatch slack pathway, Crassulacean acid metabolism, Photorespiration and glyoxylate pathway with significance. Photosynthetic formation of hydrogen. Nitrogen fixation and role of nitrogenase, anammox reactions.		15 Hrs
UNIT IV	Inborn errors of metabolism and nutritional disorders PEM (Kwashiorkar and Marasmus). Diabetes: Type I, Type II, Gestational. Glycogen storage disorders: Von Gierke's disease, Cori's disease, Andersen's disease, McArdle's disease. Amino acid metabolism- PKU, Alkaptonuria. Lipids: Atherosclerosis Nucleic acids - Gout, Lesch Nyhan syndrome.		15 Hrs

	Suggested reading	
	<p>1. Guyton, Text book of Medical Physiology, Saunders Publishers, 12th edition, 2010</p> <p>2. Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin, January 2010,</p> <p>3. Proteins: biotechnology and biochemistry, 1st edition (2001), Gary Walsch, Wiley, USA</p> <p>4. Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.</p> <p>5. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.</p> <p>6. Outlines of Biochemistry: 5th Edition, Erice Conn & Paul Stumpf ; John Wiley and Sons, USA</p> <p>7. Fundamentals of Biochemistry. 3rd Edition (2008), Donald Voet & Judith Voet , John Wiley and Sons, Inc. USA</p> <p>8. Lehninger, Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY.</p> <p>9. Biochemistry: 7th Edition, (2012), Jeremy Berg, Lubert Stryer, W.H.Freeman and company, NY</p> <p>Practical References</p> <p>1. Biochemical Methods for Agricultural Sciences- Sadasivam and Manikam. Wiley Eastern Limited, 1992..</p> <p>2. Practical Clinical Biochemistry- Harold Varley, CBS; 6 edition (1 December 2006)</p> <p>An Introduction to Practical Biochemistry (3rd Edition)- David T Plummer. Tata McGraw-Hill Publishing Company Limited, 1992.</p>	

	Course Code: MSBTDC101P	Course Title: Biochemistry and metabolism	
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr.No.	Course Contents (Topics & subtopics)		
1	Isolation of starch from potato and its estimation by Anthrone method.		
2	The isolation and assay of glycogen from liver and skeletal muscles of bird / mammal		
3	Estimation of Vitamin C from fruits		
4	Isolation of cholesterol and lecithin from egg yolks.		
5	Estimation of Creatinine in blood / urine. Estimation of urate/creatinine ratio to diagnose Lesch-Nyhan syndrome		
6	Isolation of Rhizobia from root nodules of leguminous plants		
7	Estimation of leghaemoglobin		

Syllabus for Department of Biotechnology (M.Sc. Sem I)

	Course Code: MSBTDC102T	Course Title: Immunology	
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Advanced Immunology Antigen presentation. Secondary signaling, co-stimulation, Cell signaling in immune response. DC activation, B cells as APC. Complements-Lectin pathway, Major Histocompatibility Complex, Polymorphism		15 Hrs
UNIT II	Clinical Immunology & Effector Mechanism Cytokines: properties, receptor, antagonists, diseases, Therapeutic use of cytokines. Vaccine development (Recombinant, Combined and polyvalent vaccines), Antigen Antibody reactions in diagnostics. Mucosal immunity, Peyer's patches, gut barriers, oral immunization, Oral tolerance, Cytotoxic response, ADCC, NK cells, CTL, Th, T regulation, Immunoregulation, anergy, tolerance, anti idiotypic.		15 Hrs
UNIT III	Immunological diseases Autoimmunity mechanisms, altered antigens, Systemic Lupus erythematosus, Graves diseases, Rheumatoid arthritis, Myasthenia Gravis, Multiple sclerosis, animal models of autoimmunity Transplantation immunology, GvH. Immunodeficiency: phagocytic, humoral, CMI, combined HLA association with disease.		15 Hrs
UNIT IV	CMI and imaging, Cancer Immunology and Psycho-neuro-immunology Cell Cytotoxicity, mixed lymphocyte reaction, Apoptosis, Cell cloning, Reporter Assays, In-situ gene expression techniques; In vivo cell tracking techniques; Microarrays. Tumour antigens, immune response to cancer, immunotherapy. Connections of CNS to immune system and vice versa, Psychological modulation of immunity, stress and immunity, implication for diseases, functional significance –inflammation and acute phase response, role of glucocorticoids in stress response.		15 Hrs

	Suggested reading	
	<p>1. Immunology 5th ed Janis Kuby, W.H.Freeman & Co Ltd; 5th Revised edition.</p> <p>2. Fundamental Immunology 5th edition (August 2003): by William E., Md. Paul (Editor) By Lippincott Williams & Wilkins Publishers</p> <p>3. Essential Immunology, Ivan M. Roit (1994)– Blackwell Scientific Pub, Oxford.</p> <p>4. Cellular and Molecular Immunology, 3rd ed, Abbas, Saunders; 7 edition (11 June 2011)</p> <p>Practical References</p> <p>1. Practical immunology, Frank Hay, 4th Edition , Blackwell Science</p> <p>2. Medical Microbiology, Ananthnarayan</p> <p>3. Introduction to Practical Biochemistry, D.T. Plummer, Tata MacGrawHill</p> <p>4. A Handbook of Practical Immunology – G P Talkwar</p> <p>Text Book of Medical Biochemistry, Praful Godkar. Bahalani Publishers.</p>	

	Course Code: MSBTDC102P	Course Title: Immunology	
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr.No.	Course Contents (Topics & subtopics)		
1	Quantification of antigen using Single Radial Immuno-Diffusion		
2	Double Immuno-diffusion		
3	Immuno-diffusion and immune-electrophoresis (electrophoresis of serum and then reaction with anti-whole human serum antiserum)		
4	Serum electrophoresis		
5	In-vitro demonstration of phagocytosis and calculating phagocytic index.		
6	Demonstration of HLA typing		
7	Latex bead agglutination / precipitation test for detection of rheumatoid factor (RF).		
8	Video demonstration or field visit		

Syllabus for Department of Biotechnology (M.Sc. Sem I)

	Course Code: MSBTDE101T	Course Title: Biochemical and Biophysical Techniques	
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Microscopic techniques AFM, Fluorescence Microscopy, Confocal microscopy, cryotomy scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy, singlecell imaging. Environmental SEM, and its advantages.		15 Hrs
UNIT II	Spectroscopy Introduction, principle and analysis using UV/visible spectrophotometer, fluorescence spectroscopy, circular dichroism, NMR and ESR spectroscopy , Molecular structure determination using X-ray diffraction, X ray crystallography and NMR, Molecular analysis using light scattering, mass spectrometry and LC-MS, GCMS, and surface plasma resonance methods, IR.		15 Hrs
UNIT III	Chromatography and Radioisotopy Introduction, principle and analysis using HPTLC, HPLC, GLC, Affinity chromatography and its types IEF and 2 D electrophoresis. Applications of the above techniques. Radioisotopes Techniques- Radio assay (nature of radioactivity, units, decay, half-life, detection/measurement), scintillation counting, safety aspects and applications of radioisotopes.		15 Hrs
UNIT IV	Histochemical and Immunotechniques Antibody generation, blotting techniques, Immuno-precipitation, Flow cytometry and immunofluorescence, detection of antigens in living cells, <i>in situ</i> localization by techniques such as FISH and GISH.		15 Hrs

	Suggested reading	
	1. Principles and Techniques of Biochemistry and Molecular Biology, 7th edition Wilson K.M., Walker J.M., Cambridge University Press, UK (2010), 2. Biochemical spectroscopy. Vol 46 of Methods in Enzymology. (1995) Kenneth Sauer. Academic Press, USA 3. Modern experimental biochemistry 3rd edition Publisher, USA. edition. (2000) Rodney Boyer. Prentice Hall 4. Analytical Biochemistry, 3 edition, (1998), David Holmes, H.Peck , Prentice Hall, UK. Practical References 1. An Introduction to Practical Biochemistry (3rd Edition) – David TPlummer. Tata McGraw-Hill Publishing Company Limited, 1992. 2. Principles and techniques in biochemistry, Wilson and Walker	

	Course Code: MSBTDE101P	Course Title: Biochemical and Biophysical Techniques	
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr.No.	Course Contents (Topics & subtopics)		
1	Extraction of pigments from biological sources – plants and/or microorganisms and study of their absorption spectrum in visible light		
2	Verification of Beer lamberts law and calculation of molar extinction coefficient of a coloured chemical compound of known molecular weight		
3	Use of UV spectrophotometry to determine the concentration of protein		
4	Demonstration and interpretation of NMR, HPLC, GC readouts		
5	Separation of sugars in coconut water using TLC		
6	Use of affinity chromatography for purification of antibodies from serum		
7	Visit to a facility housing EM and other analytical tools		

	Course Code: MSBTMN101T	Course Title: Research Methodology	
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	<p>Scientific Method: Defining research, Purpose of research, Scientific method and scientific principle, Characteristics of a good research, Types of research study, Study design</p> <p>Literature survey: Importance of a Good Literature Review, Types of Literature Reviews- Argumentative Review, Integrative Review, Historical Review, Methodological Review, Systematic Review, Theoretical Review, Structure and Writing Style- Organization of Literature Review, Common Mistakes to Avoid</p>		15 Hrs
UNIT II	<p>Design of Research Problem: Significance of Research Problem, Identification of research problem, Research problem statement, Basic characteristics of research problem, formulation of research problem, Variable relationships, revisions and finalization of research problem, Research hypothesis statement and significance, characteristics of good research hypothesis</p>		15 Hrs
UNIT III	<p>Design of Experiments and data collection Different research designs, Experiments, dependent, independent and controlled variables, Randomization Statistical replication, blocking, one factor at a time experiments, multifactorial experimental designs.</p>		15 Hrs
UNIT IV	<p>Data manipulation, analysis and Inference: drawing Data entry and quality control, exploratory data analysis, descriptive data analysis, data visualization, hypothesis testing- parametric and non-parametric test, Statistical learning-regression models, neural networks, principle component analysis, classification strategies</p>		15 Hrs
	Suggested readings		
	<ol style="list-style-type: none"> 1. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (Paperback) by John W. Creswell, SAGE Publications(2002) 2. Practical Research: Planning and Design, by Paul D. Leedy, Jeanne Ellis Ormrod, Prentice Hall(2004) 3. The Literature Review: Six Steps to Success by Lawrence A. Machi, Corwin Publishers(2008) 4. The Visual Display of Quantitative Information by Edward R. Tufte, Graphics Press(2006) 		

Syllabus for Department of Biotechnology (M.Sc. Sem II)

	Course Code: MSBTDC201T	Course Title: Bioprocess Technology	
	M (Masters) BT (Biotechnology) (Core Course 6) T (Theory) P (Practical)		
	Course Credit:4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Concepts of basic mode of fermentation processes Strain improvement for increased yield and other desirable characteristics; Upstream processing: Media formulation, optimization, Sterilization; Bioreactor designs; classification of fermenters: Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermenter design: Mechanically agitated, Pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters.		15 Hrs
UNIT II	Downstream processing Bio separation: Filtration, centrifugation, sedimentation, flocculation; Cell disruption; Liquid-liquid extraction; Purification by chromatographic techniques; Reverse osmosis and ultrafiltration; Drying; Crystallization; Storage and packaging; Treatment of effluent and its disposal.		15 Hrs
UNIT III	Applications of enzymes in food processing Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup, Interesterified fat, Hydrolyzed protein; baking by amylases; deoxygenation and desugaring by glucoses oxidase; beer mashing and chill proofing; cheese making by proteases.		15 Hrs

UNIT IV	Applications of Microbes in food process operations and production Fermented foods: Bread, Yoghurt, cheese, Sauerkraut, Cucumbers, Fermented meat and Fermented fish; Food ingredients and additives prepared by fermentation and their downstream processing: Xanthan, Dextran and Pullulan; Production of colours and flavours; production of SCP; Traditional Industrial Bioprocesses: Anaerobic Bioprocesses (Ethanol, Lactic acid, acetone/Butanol Production), Aerobic processes (Citric acid, Baker's yeast, Penicillin, High fructose corn syrup production); Bacteriocins from Lactic acid bacteria- Production and application in food preservation; Production of microbial polyesters: polyhydroxyalkanoates.	15 Hrs
	Suggested readings	
1.	Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.	
2.	Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood cliffs, 2002.	
3.	Crueger and Crueger. Biotechnology: A textbook of Industrial Microbiology, 2004	
4.	El-Mansi, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd, UK, 2007	
5.	Sibi G. Industrial Microbiology and Biotechnology, 1st Edition, Himalaya publishing House, 2018	
6.	Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991	
7.	Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.	
8.	Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973	

Sr. No.	Course code: MSBTDC201P Course Contents (Topics & subtopics)	
1.	Demonstration of Plackett-Burman design for formulation of Fermentation media.	
2.	Pigment production and isolation from a microbial source (yeast, Fungi or bacteria).	
3.	Physicochemical characterization of industrial effluents.	
4.	Detection of different food enzymes by different tests (amylase, catalase, invertase, papain, pectinase, pepsin).	
5.	Study of pickling process (Sauerkraut/ pickled cucumbers) with respect to physical, chemical/biochemical and biological changes occurring during the pickling process	
6.	Video demonstration or field visit.	

Syllabus for Department of Biotechnology (M.Sc. Sem II)

	Course Code: MSBTDC202T	Course Title: Molecular biology	
	Course Credit: 4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	Transcription Transcription in prokaryotes and Eukaryotes: Promoters, initiation, elongation, termination and anti-termination. Initiation factor, role of transcription factors, Regulation of RNA polymerase. Transcription in cell organelles. Types of RNA polymerases. RNA processing in eukaryotes: modifications, splicing and splicing machinery, processing of RNA, RNA editing.		15 Hrs
UNIT II	Translation Translation in Prokaryotes and Eukaryotes: Codon assignments, Wobble hypothesis, initiation, elongation, and termination, Modification folding and transport protein. Molecular chaperons in folding, Protein sorting and trafficking using signal proteins.		15 Hrs
UNIT III	Mobile DNA elements DNA rearrangement, RNAi, regulation of translation. Post translational modification. Mobile DNA elements, Transposable elements in bacteria, Controlling elements in TnA and Tn 10 transposition. SINES and LINES, retrotransposons		15 Hrs
UNIT IV	Genomics and Proteomics: an overview Omes and omics, Concepts and applications Genome overview at the level of Chromosome (with model organisms as example); Strategies for large scale DNA sequencing- Whole genome analysis techniques, Next generation sequencing methods; Organization, structure and mapping of genomes (with model organisms as example)		15 Hrs

	Suggested reading	
	1. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA 2. Molecular Biology of the Gene, 6th Edition (2008), James D. Watson, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA 3. Molecular Biology, 5th Edition (2011), Weaver R., McGraw Hill Science. USA 4. Fundamentals of Molecular Biology, (2009), Pal J.K. and Saroj Ghaskadbi, Oxford University Press. India 5. Molecular Biology: genes to proteins, 4th edition (2011), Burton E Tropp Jones & Bartlett Learning, USA 6. Discovering genomics, Proteomics and Bioinformatics (2006) Malcolm Campbell, Laurie J. Heyer Benjamin Cummings; 2nd edition. 7. Molecular Cloning a laboratory manual. Sambrook and Russel (Practicals)	

	Course Code: MSBTDC202P	Course Title: Molecular Biology	
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr.No.	Course Contents (Topics & subtopics)		
1	Extraction of genomic DNA from bacteria and blood		
2	Perform transformation of bacteria		
3	Problems on RE digests / RFLP		
4	Demonstration of ligation reaction		
5	Conjugation		
6	Induction of β -Galactosidase in of <i>E. coli</i>		

Syllabus for Department of Biotechnology (M.Sc. Sem II)

	Course Code: MSBTDE201T	Course Title: IPR, Biosafety, GMO and Environment	
	M (Masters) MB (Biotechnology) IT2 (Inter-Disciplinary Elective 2) T (Theory) P (Practical)		
	Course Credit:4	Total contact hours: 60 Hrs	
Sr. No.	Course Contents (Topics & subtopics)		Reqd. hours
UNIT I	<p>Introduction to Intellectual Property: patents, trademarks, copyright and related rights, Industrial design, traditional knowledge, Geographical indications, protection of new GMOs, International framework for protection of IP</p> <p>Biotechnology and the law: Objective, evolution, basic structure of gene, techniques, applications, commercial potential of biotech inventions, rationale for IPR protection.</p> <p>Concept of prior art Patenting biotech inventions: Objectives, concept of novelty, concept of inventive step, microorganisms; Moral Issues in patenting biotech inventions; Searching international databases; country wise patent searches (USPTO, EPO, India etc.)</p>		15 Hrs
UNIT II	<p>Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting- requirement, procedures and costs</p> <p>Patent infringement- meaning, scope, litigation, case studies and Examples.</p> <p>Biosafety: Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs.</p>		15 Hrs

UNIT III	Genetically modified microorganisms: examples and methods. Humulin, ice minus bacteria and GM bacteria in bioremediation. Use of PCR as GMO identification tool. Risks and controversies related to use of genetically modified microorganisms. Indian GMO research information system (IGMORIS). Arabidopsis as a model plant in studies in genetic engineering. Protocols for food and feed safety assessments: Acute oral safety studies in rats and mice, Sub-chronic feeding study in rodents, Protein thermal stability, Pepsin digestibility and Live stock feeding study.	15 Hrs
UNIT IV	Solid waste treatment. Pollution indicators and biosensors. Biodegradation of xenobiotics and pesticides. Phytoremediation. Biodegradation of waste from food, textile, petrochemical and paper industries. Removal of oil spillage and grease deposits.	15 Hrs
	Suggested readings	
	<ol style="list-style-type: none"> 1. Protocols for food and feed safety assessments of GE crops / DBT 2008 (http://igmoris.nic.in/files/Coverage1.pdf) 2. Genetically modified Bacteria in agriculture, N. Amarger, Biochimie84, 1061-1072. 3. Detection of genetically modified organisms in food, Farid E. Ahmed, Trends in Biotechnology, 2002, 20(5), 215-223 4. Genetic analysis: Gene, genomes and networks in Eukaryotes, Philip Meneely, Oxford University Press 	

	Course Code: MSBTDE201P	Course Title: IPR, Biosafety, and GMO	
	Course Credit: 2	Total contact hours: 60 Hrs (2 batches)	
Sr. No.	Course Contents (Topics & subtopics)		
1.	Study of a patent and developing a hypothetical patent (SOP) submit for Exam.		
2.	Use of Microsoft PowerPoint I Corel Draw to prepare a poster (ideally on a paper from peer-reviewed journal no more than 5 years old - to be brought for practical exam)		
3.	Video Demonstration of a production process or Industrial visit		
4.	Bioremediation- isolation of metal tolerant organisms & study their growth characteristics and pattern		
5.	Composting – physical & chemical parameters		