

SYLLABUS

for

Choice Based Credit System (CBCS)

M.Sc. ZOOLOGY

(w.e.f. 2019 - 20)

PATNA WOMEN'S COLLEGE

Autonomous

PATNA UNIVERSITY

3rd Cycle NAAC Accredited at 'A' Grade with CGPA 3.58/4

"College with Potential for Excellence" (CPE) Status Accorded by UGC

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Proposed Syllabus for M.Sc. Part – I in Zoology

Semester	Core Course (CC)	Elective Course (EC)	Discipline Specific Elective Course (DSE)	Generic Elective Course (GE)	Skill Enhancement Course (SEC)	Ability Enhancement Compulsory Course (AECC)
1	MZOO CC-101 Functional Biology of Invertebrates and Chordates					MAECC-101 Environmental Sustainability & Swachha Bharat Abhiyan Activities
	MZOO CC-102 Molecular Cell Biology					
	MZOO CC-103 Genetics					
	MZOO CC-104 Practical (Core)					
2	MZOO CC-205 Environmental Science				MZOO SEG-201 Solid Waste Management	
	MZOO CC-206 Bio-instrumentation and Biostatistics					
	MZOO CC-207 Biochemistry					
	MZOO CC-208 Biosystematics and Evolution					
	MZOO CC-209 Practical (Core)					

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PATNA WOMEN'S COLLEGE
Course Structure: M.Sc. (Zoology)

M.Sc. Part -1

First Semester: 4 Core Papers

Theory	Marks	Total
M ZOO CC- 101 Functional Biology of Invertebrates	70	
M ZOO CC- 101 Internal Assessment	30	100
M ZOO CC- 102 Molecular Cell Biology	70	
M ZOO CC- 102 Internal Assessment	30	100
M ZOO CC- 103 Genetics	70	
M ZOO CC- 103 Internal Assessment	30	100
Practical		
M ZOO CC- 104 Practical (Core)	70	
M ZOO CC- 104 Internal Assessment	30	100

Second Semester: 4 Core Papers

Theory	Marks	Total
M ZOO CC- 205 Environmental Science	70	
M ZOO CC- 205 Internal Assessment	30	100
M ZOO CC- 206 Bioinstrumentation & Biostatics	70	
M ZOO CC- 206 Internal Assessment	30	100
M ZOO CC- 207 Biochemistry	70	
M ZOO CC- 207 Internal Assessment	30	100
M ZOO CC- 208 Biosystematics & Evolution	70	
M ZOO CC- 208 Internal Assessment	30	100
Practical		
M ZOO CC- 209 Practical (Core)	70	
M ZOO CC- 209 Internal Assessment	30	100

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DETAILS OF P.G. COURSE IN ZOOLOGY UNDER CBCS

Sem	Course Code/ Paper Code	Nature of Course/ Paper	Marks	Marks of CIA	Marks of ESE	Passing criterion	Qualifying Criterion
SEMESTER I	MZ00CC-101	FUNCTIONAL BIOLOGY OF INVERTEBRATE S AND CHORDATES	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00CC-102	MOLECULAR CELL BIOLOGY	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00CC-103	GENETICS	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00CC-104	PRACTICAL	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	M AECC-101	ABILITY ENHANCING COMPULSORY COURSE-1	100	50	50	45% in CIA 45% in ESE	Qualifying

6/29/2018

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Semester	Course/Code Paper Code	Nature of Course/Paper	Marks	Marks of CIA	Marks of ESE	Passing criterion	Qualifying Criterion
SEMESTER II	MZ00CC-205	ENVIRONMENTAL SCIENCE	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00 CC-206	BIOINSTRUMENTATION AND BIOSTATISTICS	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00CC-207	BIOCHEMISTRY	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00CC-208	BIOSYSTEMATICS AND EVOLUTION	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	MZ00CC-209	PRACTICAL	100	30	70	45% in CIA 45% in ESE	Marks decide class/ CGPA
	HZ00SEC-201		100	50	50	45% in CIA 45% in ESE	Qualifying

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SEMESTER - I

MZ00-CC101

Core Course (CC- 1): Functional Biology of Invertebrates and Chordates Full Marks - 70

Time: 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

Unit - I

- 1.1 Organization of coelom and its significance
- 1.2 Patterns of feeding and digestion in invertebrates
- 1.3 Invertebrate larvae: Types and significance

Unit - II

- 2.1 Respiratory pigments in different phylogenetic groups
- 2.2 Organs of Respiration in Invertebrates: Gills, Lungs and Trachea
- 2.3 Mechanism of Respiration in Invertebrates

Unit- III

- 3.1 Organs of respiration in vertebrates: Gills, ARO and Lungs
- 3.2 Principles of gaseous exchange and Fick's modified equation
- 3.3 Transport of gases in blood and body fluid
- 3.4 Regulation of respiration (Neural and chemical control)
- 3.5 Respiratory adaptations at higher altitude and in diving mammals

Unit - IV

- 4.1 Patterns of nitrogenous excretion in different phylogenetic groups
- 4.2 Organs of excretion: Coelomoducts, nephridia, malpighian tubules and kidney
- 4.3 Mechanism of osmoregulation and excretion in aquatic (freshwater and marine) and terrestrial animals
- 4.4 Mechanism of acid-base balance

Unit - V

- 5.1 Thermoregulation in vertebrates
- 5.2 Mechanism ^{and} of energetic of muscle contraction (Skeletal)
- 5.3 Physiology of electrical and synaptical transmitters in neurons
- 5.4 Neurotransmitters and their functions
- 5.5 Acoustico-lateral system and electroreception in aquatic vertebrates

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SEMESTER – I

MZOO-CC102

Core Course (CC- 2): Molecular Cell Biology

Full Marks – 70

Time: 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

Unit I:

(A) Bio membrane

- 1.1 Molecular composition, arrangement and functional consequences
- 1.2 Models of bio-membrane
- 1.3 Transport across bio-membrane: diffusion, active transport and membrane pumps (P-type pump, V-type pump and ABC transporter)
- 1.4 Cotransport by symporters and antiporters

(B) Cytoskeleton

- 1.5 Microtubules and microfilaments: Structure and dynamics
- 1.6 Role of Kinesin and Dynein in intracellular transport
- 1.7 Axonal transport and cell movement (with respect to non-muscle motility)

Unit II: DNA replication

- 2.1 Outline of prokaryotic replication
- 2.2 Replication features of single stranded phages
- 2.3 Mechanism and machinery of replication in eukaryotes
- 2.4 DNA damage and repair mechanisms

Unit III: Transcription

- 3.1 Outline mechanism of prokaryotic transcription
- 3.2 Organization of eukaryotic transcription machinery
- 3.3 General and specific transcription factors
- 3.4 Regulatory elements & DNA binding domains of transcription apparatus
- 3.5 Processing of primary transcript & RNA editing in eukaryotes

Unit IV: Translation

- 4.1 Genetic code: Codon assignment and features
- 4.2 Outline of Prokaryotic translation
- 4.3 Eukaryotes translation: machinery (Ribosome & t RNA)
- 4.4 Eukaryotes translation: mechanism (Initiation, elongation and termination)

Unit V: Intra cellular protein trafficking:

- 5.1 Targeting proteins to ER: Signal hypothesis
- 5.2 Co- and post – translational modifications of proteins
- 5.3 Trafficking mechanisms:
 - (a) Vesicular transport
 - (b) Protein sorting
 - (c) Endocytosis and exocytosis

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SEMESTER – I

MZ00-CC 103

Core Course (CC- 3): Genetics

Time: 3 hrs

Full Marks - 70

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

Unit I: Organization of Chromosomes

- 1.1 Organization of prokaryotic chromosomes
- 1.2 Organization of eukaryotic chromosome: Nucleosome as functional particle, 30 nm chromatin fibre, higher order structure of chromatin
- 1.3 Organization of centromere and kinetochore, Organization of telomere and its maintenance
- 1.4 Heterochromatin: Types, organization, formation and significance
- 1.5 Structural organization and functional significance of Polytene and Lampbrush chromosomes.

Unit II: Microbial genetics

- 2.1 Transformation, conjugation, transduction and sex-duction in bacteria
- 2.2 Construction of linkage map in bacteria
- 2.3 Molecular mechanism of recombination

Unit III: Cell cycle

- 3.1 Stages and check points in cell cycle
- 3.2 Genetics of cell cycle regulation: Role of cyclins and CDKs
- 3.3 Molecular basis of cellular check points

Unit IV: Sex determination and dosage compensation

- 4.1 Genetic and Molecular basis of sex determination in *Caenorhabditis elegans*, *Drosophila* & human
- 4.2 Genetic basis of dosage compensation in *Caenorhabditis elegans*, *Drosophila* & mammals

Unit V: Techniques & Methods in genetics

- 5.1 DNA sequencing: Base destruction method, chain termination method and automated sequencing, pyro- sequencing and whole genome short-gun sequencing.
- 5.2 DNA amplification: Polymerase chain reaction, its application and limitations.
- 5.3 DNA finger printing: VNTR profiling, STR profiling (Autosomal & Y Chromosome), mitochondrial DNA profiling and SNP profiling
- 5.4 Genome expression analysis: Southern, Northern & Western blotting, Reverse Transcription PCR, DNA micro array.

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MZOO-CC 104
Core Course (CC-4) Practical

SEMESTER - I

Full Marks - 70

1st Sitting

1. Squash preparation using any of the following: 10
 - (a) *Chironomus/Drosophila* larvae for polytene chromosomes
 - (b) Onion root tip for mitosis and mitotic index
 - (c) Grasshopper testes for meiosis and related features
2. Experimental demonstration (any one of the following): 10
 - (a) Enumeration of RBC
 - (B) Enumeration of WBC (TC and DC)
 - (C) Preparation of a histological slide of the given paraffin section/whole mount of an invertebrate larva 05
3. Identification and comments upon spots (cytological slides: Nos. 02) 05

2nd Sitting

4. Identification and comments upon spots (invertebrate slide-03, vertebrate slide-02) 10
5. Genetics (any of the following) 10
 - (a) Solving problems on Mendelian principles and sex-linked inheritance
 - (b) Preparation of linkage map based on data from *Drosophila* crosses and tetrad analysis in *Neurospora*
 - (c) Pedigree analysis in human
6. Class records, charts/ models & field collection 10
7. Viva-voce 10

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SEMESTER – II

MZOO-CC205

Core Course (CC- 5): Environmental Science

Time : 3 hrs

Full Marks : 70

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

Unit I: Concept and Dynamics of ecosystem

1.1 Abiotic factors and Biotic factors.

1.2 Energy flow

(a) Lindemann's rule of trophic dynamics

(b) Energy flow models

1.3 Biogeochemical cycles: Nitrogen, Carbon, Sulphur and Phosphorous cycle

1.4 Hydrological cycles

Unit II: Principles pertaining to limiting factors

2.1 Liebig's Law of minimum, Shelford's Law of tolerance

2.2 Concept & Law of limiting factors

2.3 Factors compensation and ecotypes

Unit III: Population Growth, Predation and Regulation

3.1 Demography: Life tables, Generation time, Net reproductive rate, Reproductive value

3.2 Population growth: Exponential growth, Verhulst-Pearl logistic growth model.

3.3 Population regulation extrinsic and intrinsic mechanisms

3.4 Concept of niche, niche width and overlap, fundamental and realized niche, resource partitioning character displacement

Unit IV: Global Environmental Issues

4.1 Climate Change

4.2 Carbon Footprint

4.3 Water Security – conservation of surface and ground water

4.4 wildlife conservation

(a) Causes of extinction

(b) National and International efforts for conservation (CITIES, IUCN, CBD)

(c) National parks and sanctuaries

(d) Biosphere reserves

(e) Wildlife protection Acts

Unit V: Pollution Biology

5.1 Pollutants, their sources and classification

5.2 Causes, effects and control of Water and Air Pollution

5.3 Biomagnification and Eutrophication

5.4 Thermal and Radioactive pollution

5.5 Emerging pollutants: POPs, Pharmaceuticals

5.6 Bio-indicators as index of pollution and their significance

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SEMESTER – II

M200 CC-206

Core Course (CC- 6) Bio-instrumentation & Biostatistics

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

Unit – I

- 1.1 Principles and uses of analytical instruments – pH meter, colorimeter, Spectrophotometer, Ultra-centrifuge.
- 1.2 Microscopy – Principles of light, Transmission Electron, Scanning Electron, Fluorescence, Phase-contrast and Confocal Microscopes Photomicrography.

Unit – II

(A) Separation techniques

1. Electrophoresis: SDS PAGE, Agarose gel electrophoresis
2. Chromatography: Column, GLC, HPLC
3. Organelle separation by centrifugation
4. Cell separation by flow cytometry and density gradient centrifugation

(B) Immunological techniques

1. Radio- immunoassay (RIA)
2. Enzyme-linked Immunosorbent assay (ELISA)

Unit – III

- 4.1 Basic concepts in Biostatistics (sampling design, data collection and scaling techniques)
- 4.2 Mean: Arithmetic, Geometric & Harmonic Mean
- 4.3 Standard Deviation
- 4.4 Analysis of Variance (ANOVA)

Unit-IV

1. Correlation (Karl Pearson and Rank's correlation)
2. Regression

Unit –V

- 1.1 Rules of probability
- 1.2 Binomial probability distribution
- 1.3 Poisson probability distribution
- 1.4 Normal probability distributions
- 5.5 Test of Significance
 - (a) Chi-square test
 - (b) Student's t-test

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MZOO-CC 207

Full Marks – 70

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

- 1.1 Laws of thermodynamics, internal energy, enthalpy, entropy
- 1.2 Concept of free energy, redox potential, energy rich compounds
- 1.3 Mitochondrial electron transport chain and oxidative phosphorylation

2.1 Monosaccharides and Disaccharides, Types and properties
2.3 Polysaccharides: Homopolysaccharide and Heteropolysaccharide
2.3 Glycolysis, HMP shunt, Glyconeogenesis and Glycogenolysis

- 3.1 Primary, secondary, tertiary, quaternary and domain structures
- 3.2 Stabilizing forces in protein structure
- 3.3 Peptide conformation (Ramachandran plot, helices, turns and sheets)
- 3.4 Biosynthesis of Urea
- 3.5 Free fatty acids: Synthesis and importance
- 3.6 β -Oxidation of long chain fatty acids

- 4.1 Enzyme: Classification and nomenclature
- 4.2 Mechanism of enzyme action
- 4.3 Kinetics of enzyme catalyzed reaction
- 4.4 Non-genetic Regulation of enzyme activity:
 - (a) Feedback inhibition
 - (b) Allosteric inhibition
- 4.5 Free radicals, Antioxidants and detoxification

- 5.1 General principles of fixation and types of fixatives
- 5.2 General principles of staining and types of dyes
- 5.3 General principles of histochemistry:
 - (a) Carbohydrate
 - (b) Protein
 - (c) Lipid
 - (d) Nucleic acids
 - (e) Enzymes

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SEMESTER – II

MZ00CC208

Core Course (CC- 8): Biosystematics and Evolution

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part-A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five questions (three to be answered) of 10 marks each.

Unit 1: Biosystematic

1. Definition & basic concept of Biosystematics and taxonomy, its importance and application in biology.
2. Hierarchy of categories, outline of classification of animals, important criteria used for classification up to Classes in each phylum
3. Species concept : Biological and phylogenetic, sub - species and other infra-specific categories, evolutionary relationship among taxa
4. International code of Zoological nomenclature (ICZN): operative principles, and important rules, Zoological nomenclature and scientific names of various taxa
1. Trends in taxonomy : Chemo - taxonomy, cyto - taxonomy and molecular taxonomy

Unit 2: Pattern of genetic variation and natural selection

1. Genetic polymorphisms, variation in chromosome structure, protein structure and nucleotide sequences
2. Concept of Natural Selection (Darwinian and neo- Darwinian), mode of its operation: stabilizing, directional and disruptive modes of Natural Selection

Unit 3: Molecular evolution

1. Variation in the evolution of protein and DNA sequences
2. Molecular phylogenies
3. Rates of molecular evolution and molecular clock
4. Neutral theory of molecular evolution
5. Origin of new genes and evolution of multi gene family

Unit 4: Mechanism of speciation

1. Patterns and mechanisms of reproductive isolation and its role in evolution
2. Models of speciation : sympatric and allopatric

Unit 5: Population genetics

1. Concept of Gene pool, allele frequency and genotype frequency
2. Hardy-Weinberg principle of genetic equilibrium and its mathematical derivation
3. Detailed account of destabilizing forces of genetic equilibrium: Natural selection, Mutation, Migration, Meiotic drive, and Genetic Drift

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SEMESTER - II

MZ00-CC209
Core Course (CC- 9) Practical

First Sitting

Full Marks - 70

1. Biochemical experiments (any one of the followings) 10
 - (a) Determination of salivary amylase activity
 - (b) Colorimetric estimation of glucose, urea, uric acid or albumen in a given sample
 - (c) Separation of amino acids by paper chromatography
 - (d) Biochemical detection of glucose, starch, protein or lipid in a given sample

 2. Identify and comment upon the spots of evolutionary significance (any one of the following): 10
 - (a) Archaeopteryx
 - (b) Darwin's finches
 - (c) Serial homology in cephalothoracic appendages in prawn
 - (d) Homology vs Analogy
 - (e) Adaptive radiation in beaks of birds

 3. Histochemistry; Histochemical demonstration involving the following reagents: 10
PAS, Alcian Blue, Sudan Black B, Sudan III/IV, Feulgen, Methyl green- Pyronin,
Mercury bromophenol or
Preparation of temporary mount of any two of the specimens of planktons
- Second Sitting
4. Environmental studies (any one of the following) 10
 - (i) Measurement of pH
 - (ii) Estimation of dissolved O₂
 - (iii) Estimation of free CO₂
 - (iv) Estimation of carbonate & bicarbonate alkalinity
 - (v) Composition & assessment of the taxonomic diversity/biodiversity in a habitat (of grassland, arid & wetland)
 - (vi) Estimation of the total hardness

 5. Biostatistics: 10
Standard deviation, standard error, correlation, regression, t-test

 6. Class record 10

 7. Viva-voce 10

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A- Environmental Sustanabiltiy (3 Credit)

B- Swachha Bharat Abhiyan Activities (2 Credit)

Each credit requires 10 hours of teaching- learning for theory and 20 hours for practical assignment field work

A-Unit- 1 Environmental ethics & ecosystem: Concept of sustainable development with reference to human values in western and Indian perspective, sustainable development & conservation of natural resources (Nature, factors, structure, development and people participation) development, environment- rural and urban, concept of Ecosystem

A-Unit-2 Development and its effect on environment: Environment pollution- water, air, noise etc. due to Urbanization, Industrial civilization, Concept of Global Warming, Climate change, Green House Effect, Acid rain, Ozone layer depletion, Menace of encroachment to impact on habit & haibat on indigenous flora & fauna

A- Unit- 3 Concept of Biodiversity and its conservation: environment; degradation and conservation Govt Policies, Social effects and role of social reforms in this direction. Role of scientific conservation of environmental concept of Three 'R' (reduce, reuse, recycle). Need of environmental education and awareness programme and ecological economics.

B-Unit- 4 Swachha Bharat Abhiyan: The concept of Swachhata as personal, Gandhian approach towards social and environmental moral values & concept of swachhata and its relation to moral Upgradation of society and freedom struggle, Awareness programme related to Swachhata. Role of 'Swachhagrahis' in Swachha Bharat Abhiyan.

Sanitation and hygiene, why sanitation is needed, sanitation and human rights, plantation values of nature, concept of community participation and role of state agencies. Case study of Sanitation, effects of cleanliness, diseases- infectious and vector- born ideas of spread of diseases through body and other biological fluids and excreta.

B-Unit- 5 Assignment/ Practical/ field work based on Unit- 4

or

Alternative to unit – 4 and unit- 5, a student can also enrol for Swachha Bharat Internship programme of MHRD

Student can also enroll for Swachhina Bharat Internship

SEMESTER-II

Skill Enhancement Course (SEC)

Course title: Solid Waste Management

Course code SEC-I M ZOO SEC201

Credit 5

Course content:

Unit	Topics
I	General introduction including definitions of solid waste including municipal, hospital and industrial solid waste; E-wastes; legal issues and requirements for solid waste management; solid waste management rules, 2016
II	Health and environmental issues related to solid waste management
III	Methods of waste collection, collection techniques, waste container compatibility, waste storage requirements, transportation of solid wastes
IV	Treatment and disposal techniques for solid wastes: composting, vermicomposting, autoclaving, microwaving, incineration, non-incineration thermal techniques, landfilling
V	Source reduction, product recovery and recycling recovery of biological conversion products: composts and biogas Incineration and energy recovery Integrated Waste Management (IWM)

Practical:

1. Awareness about disposal of different wastes in waste-bin (Concept of disposal of biodegradable, non-biodegradable and bio-hazardous wastes in different coloured bins)
2. Method of composting
3. Method of vermicomposting
4. Autoclaving
5. Biogas production

Assignments:

1. Global and Indian issues related to solid wastes
2. Health issues related to solid waste management
3. Environmental issues related to solid waste management
4. Disposal methods of biodegradable wastes
5. Disposal methods of non-biodegradable wastes
6. Disposal methods of recyclable wastes
7. Biomedical wastes and their disposal methods
8. E-wastes and their disposal
9. Landfilling method of solid waste disposal
10. Vermicomposting method of solid waste disposal

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