FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma/Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**CHSC-03T**		
2	**Course Title**	**INORGANIC AND PHYSICAL CHEMISTRY-I**		
3	**Course Type**	**DSC**		
4	**Pre-requisite**(if,any)	*As per Program*		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand fundamental chemical concepts of transition elements and their applications.* ➢ *Master the principles of coordination chemistry.* ➢ *Grasp the core principles of thermodynamics and apply them to various phenomena.* ➢ *Explore the world of electrochemistry and its applications.*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours -learning & Observation*	
7	**Total Marks**	**Max.Marks: 100**		**Min Passing Marks:40**

PART -B: Content of the Course		
Total No.of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)		
Unit	**Topics(Course contents)**	**No. of Periods**
I	**Chemistry of d & f-block elements** **A. d-block elements (5 hrs.)** **(i) Chemistry of elements of first transition series:** Characteristic properties of the elements of first transition series with reference to their: Electronic configuration, Atomic and ionic radii, Ionization potential, Variable oxidation states, Magnetic properties, Color, Complex formation tendency and catalytic activity. **(ii) Chemistry of elements of second and third transition series:** Electronic configuration of 4d and 5d transition series. Comparative treatment with their 3d-analogous (Group Cr- Mo-W, Co-Rh-Ir) in respect of oxidation states and magnetic behavior. **B. f-block elements (6 hrs.)** **Chemistry of Lanthanide & Actinides:** Electronic structure, oxidation states, ionic radii, magnetic, and spectral properties. Lanthanide contraction and its consequences, complex formation, occurrence and isolation, Separation of lanthanides: solvent extraction and ion exchange method. General features and chemistry of actinides, Transuranic elements, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.	12
II	**Oxidation and reduction (5 hrs)** Various definitions of oxidation and reduction, Balancing of redox reaction by ion-electron method, Latimer diagram of Chlorine and Oxygen, Frost diagram of Nitrogen and Oxygen, and Pourbaix diagrams of Iron. Predicting disproportionation and comproportionation phenomena. **Coordination Chemistry (6 hrs)** **A. Coordination compounds:**Distinction among simple salts, double salts, and coordination compounds. Terminology and nomenclature of Coordination	11

	compounds. Types of ligands based on denticity. Werner's Coordination theory and its experimental verification. Sidgwicks electronic interpretation, EAN rule with examples. Electroneutrality principle, Valence Bond Theory of transition metal complexes. Determination of structures and magnetic properties of complexes based on VBT. Chelates: Classification and their application. **B) Isomerism in coordination compounds:** Structural isomerism and Stereoisomerism (Geometrical and optical) in coordination compounds with four and six coordination numbers.	
III	**Thermodynamics-I: (5 hrs)** **A. Basic concept of thermodynamics**: System, surrounding, types of system (closed, open & isolated). Intensive & extensive properties. Thermodynamic processes: isothermal, adiabatic, isobaric, isochoric, cyclic, reversible & irreversible. State function & path functions and their differentiation, concept of heat & work. Zeroth law of thermodynamics, First law of thermodynamics. Definition of internal energy & enthalpy. Concept of heat capacity, heat capacity at constant volume & at constant pressure, and their relationship. Joule-Thomson experiment, Joule-Thomson coefficient (no derivation) & inversion temperature. Calculations of w, q, E & H for expansion of gases for isothermal & adiabatic conditions for reversible process. **B. Thermochemistry(2 hrs.)** Standard states, Heat of reaction, enthalpy of formation, enthalpy of combustion, enthalpy of solution, enthalpy of neutralization, Hess's law of constant heat of summation & its applications. Variation of enthalpy change of reaction with temperature (Kirchoff's equation). **C. Thermodynamics II (4 hrs.)** **Second law of thermodynamics:** Limitations of first law and need for the second law. Statements of second law. Carnot cycle & Efficiency of heat engine. Thermodynamic principle of working of a refrigerator (Carnot theorem). Concept of entropy: entropy change in a reversible and irreversible process; entropy change in isothermal reversible expansion of an ideal gas. Physical significance of entropy. Gibbs free energy, Gibbs -Helmholtz equation. **D.Third law of thermodynamics (1 hr)** Statement of third law, Nernst heat theorem, Absolute entropy of solids, liquids, and gases.	12
IV	**Electrochemistry-1** Electrolyte conductance: specific and equivalent conductance, measurement of equivalent conductance, effect of dilution on conductance, Kohlrausch law, application of Kohlrausch law in determination of dissociation constant of weak electrolyte, solubility of sparingly soluble electrolyte, absolute velocity of ions, ionic product of water, conductometric titrations. Single electrode potential, standard electrode potential, electrochemical series and its applications. Concept of overvoltage. Theory of strong electrolyte: limitation of Ostwald's dilution law weak and strong electrolyte, Debye-Huckel-Onsager's (DHO) equation for strong electrolytes, relaxation, and electrophoretic effect. Migration of ions: Transport number-definition and determination by Hittorf method and moving boundary method. Electrochemical cells or Galvanic cells: reversible and irreversible cells, conventional Representation of electrochemical cells. EMF of a cell, effect of temperature on EMF of cell, Nernst equation calculation of ΔG, ΔH and ΔS for cell reaction, polarization, Over potential and hydrogen overvoltage.	11
Keywords	***D & f-block elements, Coordination compounds, Werner's theory, VBT, Isomerism, Thermodynamics, Thermochemistry, Electrical/electrolytical conductance, Transport number.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Jauhar, S. P. (2010). Modern Approach to Inorganic Chemistry: A Textbook for B. Sc. I Students. Modern publishers*
2. *Bajpai, D. N. (1992). Advanced book of physical chemistry. S Chand publishing.*
3. *Sharma, k. K. & Sharma, L. K. (2016). A textbook of physical chemistry. Vikas publishing.*
4. *Bhasin, K. K. (2018). Pradeep's Inorganic Chemistry Vol.III. Pradeep publications.*
5. *Puri, S., & Sharma, L. R. (2008). Kalia "Principles of Inorganic Chemistry".*

Reference Books recommended-

Inorganic Chemistry

1. *Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.*
2. *Cotton, F. A., Wilkinson, G., &Gaus, P. L. (1995). Basic inorganic chemistry. John Wiley & Sons.*
3. *Huheey, J. E., Keiter, E. A., Keiter, R. L., & Medhi, O. K. (2006). Inorganic chemistry: principles of structure and reactivity. Pearson Education India.*
4. *Douglas, B. E., McDaniel, D. H., & Alexander, J. J. (1994). Concepts and models of inorganic chemistry, John Wiley & Sons*

Physical Chemistry

1. *Puri, L. B., Sharma, L. R., & Pathania, M. S. (2013). Principles of physical chemistry. Vishal Publishing Co.*
2. *Atkins, P. W., De Paula, J., & Keeler, J. (2023). Atkins' physical chemistry. Oxford university press.*
3. *McQuarrie, D. A., & Simon, J. D. (2004). Molecular Thermodynamics Viva Books Pvt. Ltd.: New Delhi.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.geeksforgeeks.org/d-block-elements/**
- **https://www.vedantu.com/evs/lanthanides-vs-actinides**
- **https://www.livescience.com/50776-thermodynamics.html**
- **https://byjus.com/jee/electrochemistry/**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment(CIA):30 Marks
EndSemester Exam(ESE): 70 Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **20** /**20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program: Bachelor in Science *(Diploma / Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**CourseCode**	**CHSC-03P**		
2	**CourseTitle**	**CHEMISTRY LAB. COURSE-III**		
3	**CourseType**	**DSC**		
4	**Pre-requisite(if,any)**	-		
5	**Course Learning. Outcomes(CLO)**	➢ *Understand the principle of determining transition temperature of hydrated or other allotropic salts.* ➢ *Employ the principle of determination of solubility of a given salt at different temperatures.* ➢ *Apply Born-Haber cycle to determine enthalpy and lattice energy.* ➢ *Determine strength of an acid, ionization constant of weak acid and solubility product by conductometric or potentiometric titrations.*		
6	**CreditValue**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content of the Course

Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)

Module	Topics(Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Transition Temperature** 1) Transition temperature of a salt hydrate – determination of molecular weight. 2) Determination of the transition temperature of the given substance by thermometric /dialometric method (e.g. $SrBr_2.2H_2O$ or $MnCl_2.4H_2O$). **Thermochemistry** **A. Determination of solubility:** 1) To determine the solubility of benzoic acid at different temperatures and to determine **ΔH** of the dissolution processes. **B. Calorimetry:** 1) To determine the enthalpy of neutralization of hydrochloric acid (strong acid) by sodium hydroxide (strong base) solution. 2) (a) To determine the enthalpy of neutralization of a weak acid (acetic acid) versus strong base (sodium hydroxide) and determine enthalpy of ionization of weak acid. (b) To determine the enthalpy of neutralization of a weak base (ammonium hydroxide) versus strong acid (hydrochloric acid) and determine enthalpy of ionization of weak base. 3) To determine the enthalpy of solution of solid calcium chloride and calculate the lattice energy. **Conductometry** 1) Conductometry – Determination of limiting molar conductance of a strong Electrolyte (KCl). 2) To determine the strength of the given acid (HCl or CH3COOH)conductometrically	**30**

	using standard alkali (NaOH) solution. 3) To determine the strength of strong acid and a week acid in the given mixture conductometrically against a standard alkali solution. 4) To determine the ionization constant of weak acid conductometrically. **Solubility Product** 1) To determine the solubility and solubility product of a sparingly soluble salt conductometrically. 2) Potentiometry – Determination of solubility product of a sparingly soluble substance.	
Keywords	***Solution, Acid, Alkali. Transition temperature, Thermochemistry, Temperature, Enthalpy, Conductometric titrations, Potentiometric titrations, Solubility product.***	

SignatureofConvener&Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Vishwanathan, B. & Raghavan, P. S. (2017). Practical Physical Chemistry. Viva books originals publishing.*
2. *Yadav, J. B. (2006). Advanced Practical Physical Chemisty. Krishna Prakashan Media.*
3. *Sahu, D. P.& Bapat, K. N. (2022) Unified practical chemistry, Navbodh Prakashan.*

Reference Books recommended:

1. *Moudgil, H. K. (2010). Textbook of physical chemistry. PHI Learning Pvt. Ltd.*
2. *Adamson, A. (2012). A textbook of physical chemistry. Elsevier.*
3. *Findlay, A. (1923). Practical physical chemistry. Longmans, Green.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://tech.chemistrydocs.com/Books/Physical/Advanced-Physical-Chemistry-Experiments-by-J-N-Gurtu-&-Amit-Gurtu.pdf**
- **https://byjus.com/chemistry/conductometric-titration/**
- **https://chem.libretexts.org/Courses/University_of_California_Davis/Chem_4B_Lab%3A_General_Chemistry_for_Majors_II/1%3A_Thermochemistry_(Experiment)**
- **https://www.ulm.edu/chemistry/courses/manuals/chem1010/experiment_10.pdf**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks

Continuous Internal Assessment(CIA): 15 Marks

End Semester Exam(ESE): 35 Marks

Continuous Internal Assessment(CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **G. Performed the Task based on lab. work - 20 Marks** **H. Spotting based on tools & technology (written) – 10 Marks** **I. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM(2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction

Program: Bachelor in Science *(Diploma / Degree/Honors)*		Semester - III	Session: 2024-2025
1	Course Code	CHSE-01T	
2	Course Title	BASIC ANALYTICAL CHEMISTRY	
3	Course Type	DSE	
4	Pre-requisite(if,any)	*As per Program*	
5	Course Learning Outcomes(CLO)	➢ *To understand the sampling, procedure and treatment of sample.* ➢ *To understand the analytical techniques for analysis in different types of chemical reactions.* ➢ *To understand the volumetric analysis technique.* ➢ *To understand the gravimetric analysis technique.*	
6	Credit Value	3 Credits	*Credit = 15 Hours -learning & Observation*
7	Total Marks	Max.Marks: 100	Min Passing Marks:40

PART -B: Content of the Course

Total No. of Teaching–learning Periods(01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics(Course contents)	No. of Period
I	**Qualitative and quantitative aspects of analysis** Classification of analytical Techniques, Qualitative and quantitative analysis. Classical and instrumental methods. Factors affecting choice of analytical method. Errors in chemical analysis. Types of errors: Systematic and random, Absolute and relative, Additive and proportional. Normal distribution of indeterminate errors. Statistical parameters for data evaluation: Mean, median, average deviation, standard deviation, coefficient of variation, relative standard deviation. Accuracy and precision of results. Comparison of data using F and t-test, rejection of data using Q test. Numerical problems.	12
II	**Sampling and sample treatment** Criteria for representative sample. Bulk, gross, incremental and analysis sample. Sampling statistics. Techniques of sampling of ambient air, water and soil samples. Methods of sample size reduction: Coning and quartering, rolling and quartering. Hazards in sampling. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Types of analysis: Macro, semi-micro, micro, sub-micro and ultramicro. Major, minor and trace constituents of a sample.	11
III	**Volumetric analysis** General principle. Criteria for reactions used in titrimetric analysis. Primary standards and secondary standards. Concepts of equivalent weight and molecular weight, normality, molarity and various methods of expressing concentrations. Internal and external indicators. Theories of indicators in acid-base, precipitation, redox and complexometric titrations. Calculations involving preparation of standard solutions. Stoichiometric calculations in various types of titrations.	11
IV	**Gravimetric analysis** General principles and conditions of precipitation. Concepts of solubility, solubility product and precipitation equilibrium. Numerical problems based on solubility and solubility product. Purity of precipitate: Co-precipitation and post-precipitation. Super saturation and peptization. Criteria of selection of wash liquids. Steps involved in gravimetric analysis of barium as barium sulphate.	11

Keywords	*Qualitative and quantitative analysis;errors;Accuracy;Sampling;titrimetric analysis;indicators;Gravimetric analysis*

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Pandey, O. P., Bajpai, D. N., Giri, S., Shrivastava, B. B. L., & Mishra, A. (2010). Practical chemistry (1st ed.). S. Chand & Company.*
2. *Shrivastava, B. B. L., & Mishra, A. ([Year]). Fundamentals of analytical chemistry.*

Reference books Recommended:

1. *Harris, D. C. (2000). Quantitative chemical analysis W. H. Freeman and Company.*
2. *Mikes, O., & Chalmers, R. A. (2007). Laboratory handbook of chromatographic methods Elsevier.*
3. *Christian, G. D., Dasgupta, P. K., & Snyder, S. (2001). Concepts of instrumental analysis , Oxford University Press.*

Online Resources:

- **https://edu.rsc.org/resources/analysis**
- **https://guides.loc.gov/chemistry-resources/print-materials/analytical**
- **https://www.classcentral.com/course/swayam-analytical-techniques-13896**
- **https://www.technic.com/analytical-controls/capabilities/volumetric-analysis**
- **https://chem.libretexts.org/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_11_Experiments/07%3A_Gravimetric_Analysis_(Experiment)**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 100 Marks
ContinuousInternal Assessment(CIA):30 Marks
EndSemesterExam(ESE): 70 Marks

Continuous InternalAssessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment/Seminar- **10** Total Marks -**30**	Better marks out of the two Test / Quiz**+** obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit- **4x10=40Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF CHEMISTRY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor in Science *(Diploma / Degree/Honors)*			**Semester- III**	Session: **2024-2025**
1	**Course Code**	**CHSE-01P**		
2	**Course Title**	**BASIC ANALYTICAL CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ ***To make the student aware of Common analytical method.*** ➢ ***To demonstrate the volumetric titration.*** ➢ ***To demonstrate the students about gravimetric analysis.*** ➢ ***To learn the testing of solubility, pH of soil and water.***		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**TotalMarks**	**Max.Marks:50**	**Min Passing Marks:20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods:30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture by volumetric titration. 2. Estimation of oxalic acid by titrating it with $KMnO_4$ (potassium permanganate) by volumetric titration. 3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$ (potassium permanganate). 4. Estimation of Fe(II) ions by titrating it with $K_2Cr_2O_7$ (potassium dichromate) using an internal indicator. 5. Estimation of Cu(II) ions iodometrically using $Na_2S_2O_3$ (sodium thiosulfate). 6. Determination of heat capacity of a calorimeter for different volumes. 7. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide. 8. Determination of ionization of acetic acid. 9. Determination of solubility of benzoic acid in water and determination of enthalpy of solubilization. 10. Analysis of soil: (a) Determination of pH of soil. (b) Determination of total soluble salts. (c) Determination of carbonate and bicarbonate. (d) Determination of calcium, magnesium, and iron.	**30**
Keywords	***Volumetric analysis, gravimetric analysis, water testing, soil testing.***	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental methods of chemical analysis. Himalaya Publishing House.*
2. *Sharma, L. R. (2021). Practical inorganic chemistry.*
3. *Fernelius, W. G. (2009). Experimental inorganic chemistry (Adapted by R. K. Sharma & G. Panda). New Age International Publishers.*
4. *Yadava, T. F. (2010). A textbook of soil chemistry. Kalyani Publishers.*

Reference Books Recommended:

1. *James, A. M., & Prichard, F. E. (1981). Practical physical chemistry (3rd ed, repr). Longman. Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (Eds.). (2000). Vogel's textbook of quantitative chemical analysis (6th ed.). Pearson Education India. (Original work by A. I. Vogel)*
2. *Svehla, G. (Ed.). (1978). A textbook of quantitative inorganic analysis (by A. I. Vogel). ELBS Publishers and Distributors.*

Online Resources:

- **https://swayam.gov.in/explorer**
- **https://in.indeed.com/career-advice/career-development/analytical-skills**
- **https://chemcollective.org/labtech**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- 05 Total Marks **-15**	Better marks out of thetwo Test / Quiz **+**obtained marks in Assignment shall be considered against **15** Marks

End Semester Exam (ESE):	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools& technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener& Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**BOSC-03 T**		
2	**Course Title**	**Archegoniate and Fossils**		
3	**Course Type**	**Discipline Specific course (DSC)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	➢ students will be familiar with amphibians and reptiles plants ➢ progressive evolution in plants ➢ relics of past plants ➢ diversity in plants ➢ development of seeds.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Bryophyta:** Morphology, structure, reproduction and life history, distribution, classification, evolution of gametophytes and sterilization of sporogenous tissue. General account of- Riccia, Marchantia, Anthoceros and Funaria , Economic and ecological importance of bryophytes.	12
II	**Pteridophytes:** Morphology, anatomy and reproduction, classification, evolution of stele, heterospory, telome theory and origin of seed habit, general account and life history of of Psilotum, Lycopodium, Sellaginella, Equisetum Pteris, Marsilea	11
III	**Gymnosperm :** Characteristics of Gymnosperms, the vessel - less & fruitless seed plants, Classification of Gymnosperm; Polyembryony in Gymnosperms and its role; Distribution of Gymnosperm in India; Economic importance of Gymnosperm. General account of Cycas, Pinus, Gnetum Concepts of living fossil (Cycas & Ginkgo); Angiospermic characters of Gnetum.	11
IV	**Fossil:** Fossil and fossilization, types of fossils Geological time table **Brief account of the families of Pteridospermales** –Rhynia, Calamites. **General Account and Affinities -** Cycadeoidales Pentoxylales and Cordaitales	11
Keywords	Archegonia, seedless, heterospory, fossils	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Puri, P. (1980) Bryophytes, Atma Ram and Sons, Delhi.
2. Vashishtha, B. R. (2005) Pteridophytes S. Chand and Co., Delhi.
3. Bhatnagar, S. P., Moitra, A. (1996) Gymnosperms, New Age International Pvt. Ltd., New Delhi.

Text Books Recommended –

4. Sporne, K. K. (1991) The Morphology of Gymnosperm. B. I. Publishing Pvt. Ltd., Bombay.
5. Stewart, W. N. and Ruthwell, G. W. (1993) Paleobotany and the Evolution of Plants. Cambridge Univ. Press, UK.
6. Singh, H. (1978) Embryology of Gymnosperms; Encyclopedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

e-Resources / e-books and e-learning portals

- https://study.com/learn/lesson/bryophytes-characteristics-examples.html
- https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/26%3A_Seed_Plants/26.02%3A_Gymnosperms/26.2A%3A_Characteristics_of_Gymnosperms
- https://www.google.com/search?q=fossils&sca_esv=09379ecd0b6efd91&rlz=1C1CHBD_enIN1091IN1093&sxsrf=ACQVn09ytjzqRGwbydx-p0sOZFXGRnmfcw%3A1713546819943&ei=Q6YiZvefOde5vr0PtMuyqAg&oq=fossils&gs_lp=Egxnd3Mtd2l6LXNlcnAiB2Zvc3NpbHMqAggAMg0QABiABBixAxhDGIoFMgoQLhiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgoQABiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgUQABiABEjhKlAAWPIUcAB4AJABAJgBgwKgAYcLqgEFMC41LjK4AQHIAQD4AQGYAgegAukLwgIKECMYgAQYJxiKBcICBBAjGCfCAhEQLhiABBixAxjRAxiDARjHAcICCBAAGIAEGLEDwgIKEAAYgAQYFBiHApgDAJIHBTAuMy40oAfSWw&sclient=gws-wiz-serp
- https://www.google.com/search?q=fossils&sca_esv=09379ecd0b6efd91&rlz=1C1CHBD_enIN1091IN1093&sxsrf=ACQVn09ytjzqRGwbydx-p0sOZFXGRnmfcw%3A1713546819943&ei=Q6YiZvefOde5vr0PtMuyqAg&oq=fossils&gs_lp=Egxnd3Mtd2l6LXNlcnAiB2Zvc3NpbHMqAggAMg0QABiABBixAxhDGIoFMgoQLhiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgoQABiABBhDGIoFMgUQABiABDIFEAAYgAQyBRAAGIAEMgUQABiABEjhKlAAWPIUcAB4AJABAJgBgwKgAYcLqgEFMC41LjK4AQHIAQD4AQGYAgegAukLwgIKECMYgAQYJxiKBcICBBAjGCfCAhEQLhiABBixAxjRAxiDARjHAcICCBAAGIAEGLEDwgIKEAAYgAQYFBiHApgDAJIHBTAuMy40oAfSWw&sclient=gws-wiz-serp
- https://www.google.com/search?q=pteridophytes&sca_esv=09379ecd0b6efd91&rlz=1C1CHBD_enIN1091IN1093&sxsrf=ACQVn0-V0lp75QZG3sbfKrfltXB0GPdZyA%3A1713546628592&ei=hKUiZuvFI9q-juMPkr-DkAY&oq=pter&gs_lp=Egxnd3Mtd2l6LXNlcnAiBHB0ZXIqAggAMg0QABiABBixAxhDGIoFMgoQABiABBhDGIoFMgoQABiABBhDGIoFMgUQABiABDIKEAAYgAQYQxiKBTINEC4YgAQYsQMYQxiKBTIFEC4YgAQyChAAGIAEGEMYigUyChAAGIAEGEMYigVI_ihQAFixCnAAeACQAQCYAfQBoAGiBqoBBTAuMi4yuAEBvAEA-AEBmAIEoALgBsICChAjGIAEGCcYigXCAgQQIxgnwgIKEC4YgAQYQxiKBZgDAJIHBTAuMi4yoAfOSg&sclient=gws-wiz-serp
- https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/26%3A_Seed_Plants/26.02%3A_Gymnosperms/26.2A%3A_Characteristics_of_Gymnosperms

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA):30 (By Course Teacher)	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Sciences *(Diploma / Degree/Honors)*			**Semester - III**	Session: **2024-2025**
1	**Course Code**	**BOSC-03**		
2	**Course Title**	**Lab. Course-03 (Archegoniate and Fossils)**		
3	**Course Type**	**Laboratory course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of the course students will be familiar ➢ with amphibians and reptiles plants ➢ progressive evolution in plants ➢ relics of past plants ➢ diversity in plants ➢ Development of seeds.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course

Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)

Module	Topics (Course contents)	No. of Period
Lab./Field Training/ Experiment Contents of Course	**Bryophyta:** Comparative study of the anatomy of vegetative and reproductive parts of *Marchantia, Pellia, Anthoceros, Notothylus, Funaria, Polytrichum.* **Pteridophyta:** Comparative study of the anatomy of vegetative and reproductive parts of *Psilotum, Lycopodium, Selaginella, Equisetum, Gleichenia,Pteris, Ophioglossum, Isoetes.* **Gymnosperms:** Comparative study of the anatomy of vegetative and reproductive parts of *Cycas, Ginkgo, Cedrus, Abies, Picea, Cupressus, Araucaria, Cryptomeria, Taxodium, Podocarpus, Agathis, Taxus, Ephedra* and *Gnetum.* ▪ Collection of various gymnospermic plant materials. ▪ Field work – as far practicable conveniently. **Fossil:** Study of important fossil gymnosperms from prepared photographs, slides and specimens.	**30**
Keywords	Archegonia, venter, bryophytes, pteridophytes	

Signature of Convener & Members (CBoS) :

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PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. The Practical Fossil Finder (Practical Handbook) Hardcover – 1 October 1991by Steve Parker (Author) Publishers Facts On File Inc
2. Practical Botany (Part I) ISBN #:81-301-0008-8 Sunil D Purohit, Gotam K Kukda & Anamika Singhvi Edition:2013 Apex Publishing House Durga Nursery Road, Udaipur, Rajasthan (bilingual).
3. Pandey S.K. (2012). Quick Concept of Botany. Publisher LAP LAMBERT Academic Publishing GmbH & Co. KG, Germany (ISBN: 978-3-8484-3104-5).
4. Dubey, R. C. and Maheshwari. D.K. 2012. Practical Microbiology, S. Chand & Company, Pvt. Ltd., New Delhi.
5. Pandey. B.P. 2014 Modern Practical Botany, (Vol-I) S. Chand and Company Pvt. Ltd., New Delhi.

Reference Books Recommended –

1. Principles of Paleontology Edition 3 Paperback–1 January 2006 by Arnold Miller, Michael Foote Publishers - W.H.Freeman & Co Lt

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

Online Resources–

- **e-Resources / e-books and e-learning portals**

1. **https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/69611/1/Unit-9.pdf**
2. https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/fossil-and-fossilization
3. https://palaeobotany.org

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): 15 **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 30	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY
COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/Honors)*		**Semester - III**	Session: **2024-2025**	
1	**Course Code**	**BOSE- 01 T**		
2	**Course Title**	**Natural resources and management**		
3	**Course Type**	**Discipline specific Elective (DSE)**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, the students will be able to ➢ Understand natural resources and their sustainable utilization. ➢ Knowledge on land, water, energy, and forest resources. ➢ Students will learn about the practices of natural resource management. ➢ Knowledge on the international and national efforts of natural resource management.		
6	**Credit Value**	**3 Credits**	***Credit = 15 Hours - learning & Observation***	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

Total No. of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Natural resources** ➢ Definition and types. ➢ Natural resources' conservation Role of an individual in conservation of natural recourses, Significance, ➢ Sustainable utilization of resources' : Concept, approaches economic, ecological, and socio-cultural activities.	12
II	**Land and freshwater resources** ➢ Land as a resource ➢ Soil erosion and desertification ➢ Soil degradation and management. ➢ Forest resources use and over exploitation, deforestation ➢ Water resources, use and overutilization of surface and ground water ➢ Fresh Marine and estuarine ecosystems; ➢ Wetlands threats and management strategies	11
III	**Biological Resources** ➢ Biodiversity-definition and types ➢ Value of biodiversity ➢ Biodiversity at global, national an regional levels ➢ Threats; Management strategies; ➢ Bioprospecting. IPR; CBD; National Biodiversity Action Plan). ➢ Forests: Cover and its significance (with special reference to India); ➢ Major and minor Forest products; ➢ Renewable and non-renewable sources of energy.	11
IV	**Contemporary practices in resource management** ➢ National and international efforts in resource management and conservation. ➢ Waste management practices ➢ Natural resource Accounting ➢ Environmental impact assesement EIA ➢ Geographical information System GIS ➢ Participatory Appraisal of naturl Resource ➢ Ecological Footprint with emphasis on carbon footprint,	11
Keywords	**Resources, Biodiversity, Resources management, IPR, CBD.**	

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.

Reference Books Recommended –

1, Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **https://www.sciencedirect.com/topics/social-sciences/natural-resource**
- **https://efaidnbmnnnibpcajpcglclefindmkaj/https://egyankosh.ac.in/bitstream/123456789/66166/2/Unit4.pdf**
- **https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ers.usda.gov/webdocs/publications/41964/30289_biological.pdf?v=0#:~:text=16-,What%20Are%20Biological%20Resources%3F,forests%2C%20and%20other%20natural%20lands.**
- http://surl.li/spcdd
- https://shorturl.at/ewyIP
- https://shorturl.at/cimoF

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

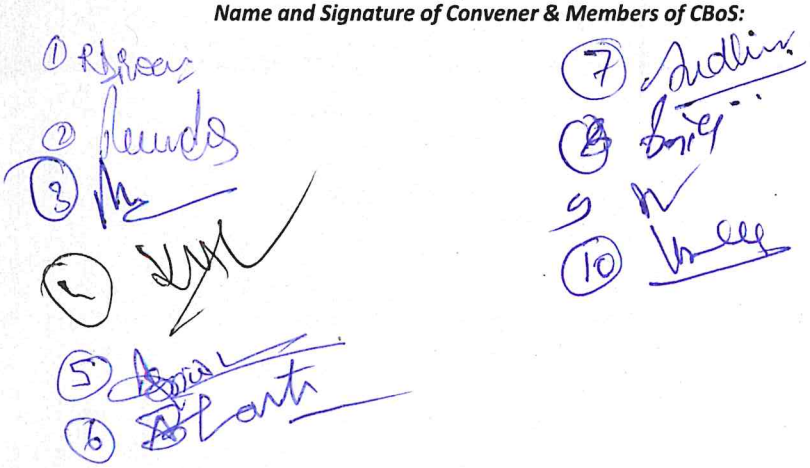
PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Exam (ESE):	**70 Marks**

Continuous Internal Assessment (CIA): 30 **(By Course Teacher)**	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE): 70	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:



FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)

DEPARTMENT OF BOTANY

COURSE CURRICULUM

PART- A: Introduction				
Program: Bachelor in Life Science *(Diploma / Degree/ Honors)*		**Semester - III**	Session: **2024-2025**	
1	**Course Code**	**BOSE -01 P**		
2	**Course Title**	**Lab course -01 (Natural resources and management)**		
3	**Course Type**	**Laboratory course**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	***at the end og then of the sesn*** O To understand natural resources and their sustainable utilization. O Acquire knowledge on land, water, energy, and forest resources. O Students will learn about the practices of natural resource management. O Acquire knowledge on the international and national efforts of natural resource management.		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**	**Min Passing Marks: 20**	

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	1) To compare protected and unprotected grassland stands using community coefficients 2) To estimate IVI of the species in a woodland using point centered quarter method. 3) To find out important grassland species using chi square test. 4) Scientific visits to a protected area, a wet land, a mangrove, NBPGR, BSI, CSIR, ICAR labs and a recognized botanical gardens or a museum. 5) To determine diversity indices (Shannon Wiener, concentration of dominance, species richness, equability and B diversity. 6) Field survey of a part of town or city to make the students aware of the diversity of plants in urban ecosystems. 7) Estimation of solid waste generated by a domestic system (biodegradable and non biodegradable) and its impact on land degradation. 8) Collection of data on forest covers of specific area. 9) Measurement of dominance of woody species by DBH (diameter at breast height) method. 10) Calculation and analysis of ecological footprint. 11) Ecological modeling.	**30**
Keywords	Community coefficient, IVI, diversity indices	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. A Handbook of Human Resource Management Practice
2. Environmental and Natural Resource Economics_ A Contemporary Approach
3. Sustainable Management of Natural Resources_ Mathematical Models and Methods (Environmental Science and Engineering Environmental Science)

Online Resources–

- **e-Resources / e-books and e-learning portals**

1) https://shorturl.at/uIMTW
2) https://shorturl.at/yFJM3

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **www.swayam.ac.in**
- **www.ignou.ac.in**
- **www.egyankosh.ac.in**
- **www.iitm.ac.in**
- **www.eskillindia.org**
- **www.eshiksha.mp.gov.in**
- **www.vlab.co.in**
- **www.internshala.com**
- **www.ndl.iitkgp.ac.in**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): 15 **(By Course Teacher)**	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE): 35	**Laboratory / Field Skill Performance: On spot Assessment** **A. Performed the Task based on lab. work - 20 Marks** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSC-03-T**	
2	Course Title	**Genetics and Biophysics**	
3	Course Type	Discipline Specific Course (DSC)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand classical genetics of inheritance • Understand variation in genes and its impact. • Understand the use of basic physical tools for the measurement of biological processes.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Chromosome and gene** 1. Techniques to study chromosomes: Karyotyping, banding, chromosome labeling, comparative genome hybridization. 2. Change in chromosome number & structure: Ploidy and rearrangement (Deletion, Duplication, Inversion &Translocation). 3. Concept of gene: Fine structure of gene, split gene, pseudogenes, non-coding genes, overlapping genes & multigene family. 4. Mutation: Classification, mechanism, repair, role in evolution.	12 (12 Hrs)
II	**Classical genetics** 1. Mendelian genetics- basic principles and interaction of genes. 2. Linkage, Crossing Over. 3. Sex-linked inheritance and pedigree. 4. Cytoplasmic inheritance.	11 (11 Hrs)
III	**Instrumentation I** 1. Simple microscopy, phase contrast microscopy, fluorescence, and electron microscopy (TEM and SEM). 2. pH meter, absorption, and emission spectroscopy 3. Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red), 4. Centrifugation principle and its types.	11 (11 Hrs)
IV	**Instrumentation II** 1. Introduction to electrophoresis. Starch-gel, agarose-gel electrophoresis, immuno-electrophoresis. 2. Introduction to the principle of chromatography. Paper chromatography,	11 (11 Hrs)

	thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC. 3. Introduction to Biosensors and their applications. 4. Radioisotopes in Biology. Autoradiography, DNA fingerprinting.	
Keywords	Gene, Genetic alteration, Spectrophotometry, Electrophoresis.	

- Part C - **Learning Resource**

Text Books, Reference Books, Other Resources -

Text Book-

- Genetics- PS Verma
- Genetics- BD Singh
- Genetics- Veer Bala Rastogi

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
- Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Online resources- https://archive.nptel.ac.in/courses/102/104/102104052/
https://onlinecourses.swayam2.ac.in/cec21_bt05/preview

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100 Marks
Continuous Internal Assessment (CIA): 30 Marks
End Semester Exam (ESE): 70 Marks

Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 20 +20 Assignment / Seminar - 10 Total Marks - 30	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1.** Objective – **10 x1= 10** Mark; **Q2.** Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener and Members of CBoS:

(Keshav Kant Sahu) (Amit Panda) (Dr. Neha Behar) (Dr. Shubha Diwan)
Dr Pramod Mahish Dr- Ujjwala Supe
Dr. Shivani Sharma (Dr. Sanjana Bhagat)
(Dr. Arun Kr. Kashyap)

Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSC-03-P**	
2	Course Title	**Genetics and Biophysics**	
3	Course Type	Discipline Specific Course (DSC) - Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Perform cellular replication. • To conduct genetic inheritance and interpretation. • Nucleic acid estimation. • Perform biological extraction, identification and measurement.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Permanent and temporary mount of mitosis and meiosis. 2. Karyotyping with the help of photographs. 3. Problems regarding Genetics and Mendelian deviations in dihybrid crosses. 4. Pedigree charts of some common characteristics like blood group, color blindness, and PTC tasting. 5. Temporary mount of Giant chromosome. 6. Photometric (colorimetric/spectrophotometric) estimation of nucleic acid. 7. Cellular fractionation by centrifugation. 8. Maintenance and operation of laminar airflow. 9. Extraction by using the Soxhlet method. 10. To identify lipids in a given sample by TLC. 11. To verify the validity of Beer's law and determine the molar extinction coefficient of NADH. 12. Operation of electrophoresis for protein.	30
Keywords	Gene, Genetic alteration, Spectrophotometry, Electrophoresis.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book-

- Genetics- PS Verma
- Genetics- BD Singh
- Genetics- Veer Bala Rastogi

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
- Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Online resources- https://archive.nptel.ac.in/courses/102/104/102104052/
https://onlinecourses.swayam2.ac.in/cec21_bt05/preview

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20 Marks** **B. Spotting based on tools & technology** (written) – **10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:

(Keshav Kant Sahu) (Amita Pande) (Dr. Neha Behar) (Dr. Shubha Diwan) Dr. Ujjwala Supe

Dr. Shivani Sharma (Dr. Sanjana Bhagat) Dr Pramod Malik

(Dr. Arun Kr. Kashyap)

Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSE-01-T**	
2	Course Title	**Environmental Biotechnology**	
3	Course Type	Discipline Specific Elective course (DSE)	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand wastewater management. • Understand the significance and scope of biodegradation. • Develop skills for bioremediation. • Develop skills for the management of xenobiotics.	
6	Credit Value	03 Credits (Credit = 15 Hours - learning & observation)	
7	Total Marks	Max. Marks: 100	Min Passing Marks: 40

Part B: Content of Course (Theory)		
Total No. of Teaching–learning Periods (01 Hr. per period)- 45 Periods (45 Hours)		
Unit	Topic (Course content)	No. of Period
I	**Environmental treatments** 1. Domestic (municipal) and industrial wastewater treatments: primary, secondary and tertiary. 2. Important microorganisms in wastewater treatment, principles of their growth and plasmid-borne metabolic activities. 3. Aerobic biological treatments: activated sludge process rotating biological contactors. 4. Anaerobic biological treatments: airlift membrane bioreactors packed bed (column reactor.)	12 (12 Hrs)
II	**Environmental degradation** 1. Biodegradation: definition and concept, ready biodegradation, ultimate biodegradation and inherent biodegradation. 2. Aerobic and anaerobic degradation pathways in microbes. 3. Biodegradation of hydrocarbon with suitable example. 4. Concept of municipal solid waste management.	11 (11 hrs)
III	**Environmental remediation** 1. Introduction, definition and concept, methods of bioremediation (in situ and ex-situ methods) 2. Bioremediation of soil (saline soil and alkaline soil) 3. Phytoremediation: concept and types. 4. Applications of bioremediation.	11 (11 hrs)

IV	**Environmental contamination** 1. Xenobiotics and recalcitrancy. 2. Xenobiotics degradation: pesticide degradation, herbicide degradation 3. Metabolism of xenobiotics. 4. Cytochrome p450 system, phase I, phase II, metabolic reactions.	11 (11 hrs)
Keywords	Wastewater management, biodegradation, bioremediation, xenobiotics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- • Murugesan A. G.and Rajakumari C-Environmental Science and Biotechnology: Theory &Techniques, MJP • Asthana D.K. and Asthana M.,-Environment: Problems and Solutions- S. Chand • Chatterji A.K., Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd
Reference Book- • Jogdand S.N.- Environmental Biotechnology- Himalaya Publishing House • Kalaichelvan P.T., I Arul Pandi- Bioprocess Technology, MJP Publishers • Rajendran, Gunashekaran- Microbial Bioremediation-MJP • Hammer & Hammer-Water & Wastewater Technology-PHI • Metcaf & Eddy-Waste water Engineering-TMH • Indushekhar Thakur- Environmental Biotechnology-I K Internation
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt41/preview http://acl.digimat.in/nptel/courses/video/102105088/102105088.html

Part D: **Assessment and Evaluation**		
Suggested Continuous Evaluation Methods: **Maximum Marks:** 100 **Marks** **Continuous Internal Assessment (CIA):** 30 **Marks** **End Semester Exam (ESE):** 70 **Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): **20 +20** Assignment / Seminar - **10** Total Marks - **30**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
End Semester Exam (ESE):	**Two section – A & B** Section A: **Q1**. Objective – **10 x1= 10** Mark; **Q2**. Short answer type- **5x4 =20 Marks** Section B: Descriptive answer type qts.,**1out of 2** from each unit-4x10=**40 Marks**	

Name and Signature of Convener and Members of CBoS:

Four Year Undergraduate Program (2024-28)
Department of Biotechnology
Course Curriculum

Part A: Introduction			
Program: Bachelor in Life Sciences (Diploma/Degree/Honors)		Semester: **III Sem**	Session:**2024-2025**
1	Course Code	**BTSE-01-P**	
2	Course Title	**Environmental Biotechnology**	
3	Course Type	Discipline-Specific Elective (DSE)--Practical	
4	Pre-requisite (if any)	As per program	
5	Course Learning Outcomes (CLO)	After completing this course, the students will be able to - • Understand and analyze physical and chemical parameters of the water bodies. • Estimate biological pollutants from the water bodies. • Determine physical and nutritional conditions of the soil. • Estimate various inorganic and organic contents from pollutants.	
6	Credit Value	01 Credits Credit =30 Hours Laboratory or Field learning/Training	
7	Total Marks	Max. Marks: 50	Min Passing Marks: 20

Part B: Content of Course (Theory)		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	Topic (Course content)	No. of Period
Lab./Field Training/ Experiment Contents of Course	1. Determination of DO, and BOD, from polluted water sample. 2. Determination of COD from a polluted water sample. 3. Bacterial examination of water by MPN test. 4. Coliform test. 5. Determination of soil pH and total organic carbon. 6. NPK determination from soil. 7. Determination of alkalinity and hardness of water. 8. Estimation of total nitrogen in Kjeldahl's method.	30
Keywords	Wastewater management, biodegradation, bioremediation, xenobiotics.	

• Part C - **Learning Resource**
Text Books, Reference Books, Other Resources -
Text Book- • Murugesan A. G.and Rajakumari C-Environmental Science and Biotechnology: Theory &Techniques, MJP • Asthana D.K. and Asthana M.,-Environment: Problems and Solutions- S. Chand • Chatterji A.K., Introduction to Environmental Biotechnology, Prentice Hall of India Pvt. Ltd
Reference Book- • Jogdand S.N.- Environmental Biotechnology- Himalaya Publishing House

• Kalaichelvan P.T., I Arul Pandi- Bioprocess Technology, MJP Publishers • Rajendran, Gunashekaran- Microbial Bioremediation-MJP • Hammer & Hammer-Water & Wastewater Technology-PHI • Metcaf & Eddy-Waste water Engineering-TMH • Indushekhar Thakur- Environmental Biotechnology-I K Internation
Online resources- https://onlinecourses.nptel.ac.in/noc21_bt41/preview http://acl.digimat.in/nptel/courses/video/102105088/102105088.html

Part D: Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks: 50 Marks** **Continuous Internal Assessment (CIA): 15 Marks** **End Semester Exam (ESE): 35 Marks**		
Continuous Internal Assessment (CIA) (By course teacher):	Internal Test / Quiz-(2): 10 +10 Assignment / Seminar + Attendance- 05 Total Marks - 15	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory / Field Skill Performance:** **A. On spot Assessment - 20** **B. Spotting based on tools & technology (written) – 10 Marks** **C. Viva-voce (based on principle/technology) - 05 Marks**	Managed by course teacher as per lab status

Name and Signature of Convener and Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF MICROBIOLOGY
COURSE CURRICULUM

PART – A: Introduction			
Program: Bachelor in Life Science (Diploma/Degree)		**Semester - III/IV**	**Session: 2024-25**
1	Course Code	MBVAC-01	
2	Course Title	Microbes and Human Health	
3	Course Type	Value Added Course (VAC)	
4	Prerequisite (If Any)	As per Program	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to – ➢ define the basic concept of Infection and disease ➢ explain various serological tests ➢ illustrate the basic knowledge of Immune status of human body ➢ identify various infectious diseases	
6	Credit Value	02 Credits	*Credit = 15 Hours - Learning & Observation*
7	Total Marks	Max. Marks: 50	Minimum Pass marks: 20

PART – B: Content of the Course

Total No. of Teaching-Learning Periods: (01 Hr. per Period) - 30 Periods (30 Hours)

Unit	Topics (Course contents)	No. of Periods
I	**Infection & Disease:** Difference between infection and disease, Important terminologies along with suitable examples; primary infection, secondary infection, contagious infection, nosocomial infections, clinical infection, subclinical infection, zoonoses, vector borne infection. Epidemic, endemic and pandemic diseases.	08
II	**Routes of entry and transmission of disease:** Portal of entry, Portal of exit, Reservoir, susceptible host. Direct contact, indirect contact, Airborne, vector borne, blood borne, non-contact vehicle transmission. Exposure, risk and standard precautions, expanded precautions. Control of routes of transmission.	08
III	**Serological reactions:** Basic concept of serological reactions, blood cell counting, Agglutination, precipitation. Blood group determination, Widal test, VDRL test. Total RBC count, Total leucocyte count, Platelet count, Differential count, Estimation of haemoglobin.	07
IV	**Viral and Bacterial infection:** Common water borne infections, air borne infections; their causes, sign & symptoms, pathogenesis, diagnosis, treatment and prevention.	07
Key Words	**Infection, Disease, Virulence, Pathogenesis**	

Name and Signature of Convener and Members of CBoS

Rashmi 10.6.24 · 10/6/24 · 10/6/24 · 10.6.24 · 10.6.24 · DR. K K Patel · Dr. Nelson Xess · S. Nagar (Dr. S. Nagar)

PART – C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended:

1. A Text Book of Microbiology; Dubey & Maheshwari.
2. General Microbiology; Vol I & II, Powar C.B. and Daginawala H.I., Himalayn Pub. House, Bombay.
3. Text book of Microbiology; Ananthanarayan R. and Paniker C.K.J. (2009). 8th edition, University Press Publication
4. A Text Book of Microbiology; P. Chakraborthy, 3rd Edn, New Central book Agency (P) Ltd, Kolkata, India 2005.

Reference Books:

1. Preventive and Social Medicine, Park and Park

- https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBMA1302.pdf
- https://www.news-medical.net/health/Modes-of-Transmission.aspx
- https://courses.lumenlearning.com/suny-microbiology/chapter/how-pathogens-cause-disease/

PART – D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 50 Marks
Continuous Internal Assessment (CIA): 15 Marks
End Semester Exam (ESE): 35 Marks

Continuous Internal Assessment (CIA): (By Course Teacher)	**Internal Test/ Quiz – (2): 10 & 10** **Assignment/ Seminar + Attendance: 05** **Total Marks: 15**	Better Marks out of the two Test/ Quiz + obtained marks in Assignment shall be considered against **15** Marks

End Semester Exam (ESE):	**Two Section – A & B** Section A: **Q1.** Objective **05 X 1 = 05 Mark**; **Q2.** Short answer type – **5X2 = 10 Marks** Section B: Descriptive answer type qts., **1 out of 2** from each unit – **4X05 = 20 Marks**

Name and Signature of Convener and Members of CBoS

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF ZOOLOGY
COURSE CURRICULUM

PART-A: Introduction				
Program:Bachelor *(Certificate / Diploma / Degree)*			**Semester – I/III/V**	Session: **2024-2025**
1	**Course Code**	**ZOVAC-01**		
2	**Course Title**	**Public Health and Hygiene**		
3	**CourseType**	**Value Added Course**		
4	**Pre-requisite**(if, any)	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ Understand the importance of hygiene. ➢ Identify current national and global public health problems. ➢ Aware about the issues of food safety, water safety, vaccination, and obesity. ➢ Create general medical awareness in daily life. ➢ Analyze the measures to live a healthy life.		
6	**CreditValue**	**2 Credits**	***Credit = 15 Hours -learning & Observation***	
7	**TotalMarks**	**Max.Marks:50**		**Min Passing Marks:20**

PART -B: Content oftheCourse

Total No. of Teaching–learning Periods (01 Hr. per period) - 30 Periods (30 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maintenance of personal hygiene:** Introduction to public health and hygiene: determinants and factors. Pollution and health hazards: Water and air borne diseases. Radiation hazards: Network Towers and electronic gadgets (recommended levels, effects and precaution). Personal hygiene: Oral hygiene, Menstrual Hygiene, Ideal hand washing methods, Ideal food keeping methods.	07
II	**Nutrition and Health:** Classification of food into micro and macro nutrients. Balanced diet. Importance of dietary fibres. Significance of breast feeding. Malnutrition anomalies: Anaemia (Iron and B12 deficiency), Kwashiorkar, Marasmus, Rickets, Goiter (cause, symptoms, precaution and cure).	07
III	**Communicable/Contagious and Non-Communicable Diseases: Communicable viral diseases:** measles, chicken pox, swine flu (their causal agents, symptoms and prevention). **Communicable bacterial diseases:** tuberculosis, typhoid, cholera (their causal agents, symptoms and prevention). **Sexually transmitted diseases:** AIDS, Syphilis (their causal agents, symptoms and prevention). **Non-communicable diseases:** hypertension, arthritis, Diabetes, peptic ulcer, obesity, depression and anxiety (their causal agents, symptoms and prevention).	09
IV	**Public Health Management & General Medical Awareness:** Vaccination, Benefits of institutional deliveries, Deworming drive: Use of Albendazole. First Aid: Electrocution, Road Accident, Burn, Lightning Strike, Envenomation. Importance of Cardiopulmonary resuscitation (CPR). Blood Donation: Eligibility, Health Screening. Road Safety: Good Samaritan, General safety precautions on Road and Motion Sickness. Fire Safety: Fire Control and Fire Extinguisher Categories.	07
Keywords	*Health, Hygiene, Nutrition, Disorders, Vaccination, Safety, Fire, Blood, Medication.*	

Signature of Convener & Members (CBoS):

PART–C:Learning Resources

Text Books, Reference Books and Others

Text BooksRecommended –

- Mary Jane Schneider (2011) Introduction to Public Health.
- Muthu, V.K. (2014) A Short Book of Public Health.

Reference Books Recommended

- Detels, R. (2017) Oxford Textbook of Public Health (6th edition).
- Gibney, M.J. (2013) Public Health Nutrition.
- Wong, K.V. (2017) Nutrition, Health and Disease.

Online Resources–

- **https://www.fda.gov/drugs/investigational-new-drug-ind-application/general-drug-categories**
- **https://www.nfpa.org/news-blogs-and-articles/blogs/2023/08/01/fire-extinguisher-types**
- **https://www.redcross.org/take-a-class/cpr/performing-cpr/what-is-cpr#:~:text=What%20Is%20the%20Purpose%20of,healthcare%20workers%20and%20emergency%20responders.**
- **https://unesdoc.unesco.org/ark:/48223/pf0000226792**

Online Resources–

- **https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001827/P001833/M029447/ET/15245666876.21Q1.pdf**
- **https://www.nhm.gov.in/images/pdf/programmes/mhs/Training_Materials/PDF_English/reading_material.pdf**

PART-D:Assessment andEvaluation

Suggested Continuous Evaluation Methods:
MaximumMarks: 50 Marks
ContinuousInternal Assessment(CIA):15 Marks
EndSemesterExam(ESE):35Marks

Continuous InternalAssessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): **10 &10** Assignment/Seminar +Attendance- **05** Total Marks -**15**	Better marks out of thetwo Test / Quiz+obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Two section – A & B** Section **A**: **Q1**. Objective – **05 x1= 05** Mark; **Q2**. Short answer type- **5x2 =10Marks** Section **B**: Descriptive answer type qts.,**1out of 2** from each unit-**4x05=20Marks**	

Name and Signature of Convener & Members of CBoS:

FOUR YEAR UNDERGRADUATE PROGRAM (2024 – 28)
COURSE CURRICULUM

PART A: INTRODUCTION			
Program: Certificate Course		**Semester- I Sem**	**Session: 2024-25**
1	Course Code	AEC 01	
2	Course Title	Environmental Studies	
3	Course Type	Ability Enhancement Course (AEC)	
4	Prerequisite (If Any)	As per requirement	
5	Course Outcome (CO)	At the end of this course, students will be able to – **CO 01:** relate the basic concept of the environment **CO 02:** explain environmental alterations **CO 03:** develop skills in environmental measurement **CO 04:** examine correction measures of the environment	
6	Credit Value	02 C	01 Credit = 15 Hrs. Teaching-Learning
7	Total Marks	Max. Marks: 50	Minimum Pass marks: 20

PART: B CONTENT OF THE COURSE		
Total No. of Teaching-Learning Periods: 30Hours/ 30Periods		
UNIT	**TOPIC (Course Contents)**	**No. of Hours**
I	**Basic Composition:** 1. Abiotic and Biotic components of the environment 2. Biodiversity—Concept, types, and measures about its protection 3. Basic concept of Bio-Geo Chemical Cycle 4. Energy Flow in an ecosystem	07
II	**Alterations in Environment:** 1. Concept and components of the pond ecosystem 2. Air pollution and measures for its control 3. Water pollution and measures for its control 4. Global warming, Climate change, and possible measures	07
III	**Measurements of Environmental Components** 1. Soil composition and methods of its analysis 2. Water analysis methods for DO, BOD, COD 3. Water analysis methods for pH, TDS, Turbidity, Salinity, and Alkalinity 4. Information about environmental factors—PM-10, PM-2.5, NO2, O3	08
IV	**Application Measures** 1. Useful microbes to control water pollution 2. Useful microbes to control soil pollution 3. Concept of Biodegradation 4. Concept of Phytoremediation	08
Key Words	**Ecosystem, Pollution, Climate Change, Biodegradation**	

Name and Signature of Convener and Members of CBOS

(Dr. Anu kr. Kangra)
Sanjana 11/06/24 (Dr. Sanjana Bhagat)
11/6/24 Dr. Shivani Sha
Dr. Ujjwala Supe
Keshav (Keshav Kant Sahu)
11/6/24 Dr. Shubha Diwan
Dr. Pramod Mahish
N. Behar 11/6/24 (Dr. Neha Behar)
Amrita Panda 11/6/2024 (Dr Amrita Panda)

PART–C: Learning Resources

Text Books, Reference Books, and Others

Text Books Recommended –

1. *Ecology and Environment, 8th Edition, P.D.Sharma, Rastogi Publication, Meerut.*
2. *Environmental Biology, 2nd Edition, P,D.Sharma, Rastogi Publication, Meerut.*
3. *Environmental Biology and Toxicology, 2nd Edition, P.D.Sharma, Rastogi Publication, Meerut.*
4. *Environmental Studies, 1st Edition, S.V.S.Rana, Rastogi Publication, Meerut.*
5. *Environmental Biotechnology, 1st Edition, S. V. S. Rana, Rastogi Publication, Meerut.*

Online Resources–

- **e-Resources / e-books and e-learning portals**

Online Resources–

- **e-Resources / e-books and e-learning portals**

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks:	**50 Marks**
Continuous Internal Assessment (CIA):	**15 Marks**
End Semester Exam (ESE):	**35 Marks**

Continuous Internal Assessment (CIA): (By Course Teacher)	Internal Test / Quiz-(2): **10 & 10** Assignment/Seminar +Attendance - **05** Total Marks - **15**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Two sections – A & B** Section **A**: **Q1**. Objective – **05 x1= 05** Mark; **Q2**. Short answer type- **5x2 =10 Marks** Section **B**: Descriptive answer type qts.,**1out of 2** from each unit- **4x05 =20 Marks**	

Name and Signature of Convener & Members of CBoS:

Sanjana 11/06/24
(Dr. Sanjana Bhargat)

Shivani Sharma 11/6/24
(Dr. Shivani Sharma)

11.6.24
Dr. Vijayalaxmi

11/06/24
(Dr. Shubha Diwan)

Neha Behar 11/6/24
(Dr. Neha Behar)

Amrita Panda
(Dr. Amrita Panda)
11.6.2024

Dr. Pramod Kumar Malviya

(Dr. Anil Kumar Kanp)