FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Diploma/Degree/Honors)		**Semester - III**	**Session:2024-2025**
1	Course Code	**MASC-03**	
2	Course Title	**Differential Equations**	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of basic Differential and Integral calculus and differential equation.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Learn various techniques of getting exact solutions of certain solvable first order differential equations and linear differential equations of second order. ➢ Understand the genesis of ordinary as well as partial differential equations. ➢ Learn about solution of first order linear partial differential equations using Lagrange's method. ➢ Know how to solve second order linear partial differential equations with constant coefficients.	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and Observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	**Contributions and Biography of Indian Mathematicians:** Aryabhatta, Varahmihir, Bhaskar-I, Shreedharacharya, Shreepati and Parmeshwar. **First Order and higher degree Differential Equations** : Differential equations of first order and first degree, Equations in which variables are separable, Homogeneous equations, Linear differential equations and equations reducible to linear form, Exact differential equations, Integrating factor, First order higher degree equations solvable for x, y and p, Clairaut's form and singular solutions, orthogonal trajectories.	15
II	**Linear and Ordinary simultaneous differential equations:** Linear differential equations with constant coefficients, Homogeneous linear ordinary differential equations. Linear differential equations of second order.Transformation of the equation by changing the dependent variable/the independent variable.Method of variation of parameters. Ordinary simultaneous differential equations.	15
III	**First order Partial differential equations:** Lagrange's solution, Some special types of equation which can be solved by methods other than general method, Charpit's general method of solution.	15

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IV	**Second and higher order Partial differential equations:** Classification of Linear partial differential equation of second order, Homogeneous and non- homogeneous equation with constant coefficients, Partial differential equation reducible to equation with constant coefficients. Monge's Method.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Dr. M. D. Rajsinghania, Ordinary and partial Differential Equation ,S. Chand and company Pvt.Ltd.
2. A.H. Siddiqi and P. Manchanda , A first course in Differential Equations with Applications, Macmillan India Ltd.

Reference Books Recommended-

3. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). J. Wiley & Sons
4. B. Rai& D. P. Choudhury (2006). *Ordinary Differential Equations - An Introduction*. Narosa Publishing House Pvt. Ltd. New Delhi.
5. Shepley L. Ross (2007). *Differential Equations* (3rd edition). Wiley.
6. George F. Simmons (2017). *Differential Equations with Applications and Historical Notes* (3rd edition). CRC Press. Taylor & Francis.
7. Ian N. Sneddon (2006). *Elements of Partial Differential Equations*. Dover Publications.

E-resources: https://onlinecourses.nptel.ac.in
https://epgp.inflibnet.aci.in
https://swayam.gov.in
https://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: **100 Marks**

Continuous Internal Assessment (CIA): **30 Marks**

End Semester Examination (ESE): **70 Marks**

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section**-A&B Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-

Dr. Omkar Nath Srivastava

Dr. S Dashputre

(Dr. P. K. Sahu)

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)
DEPARTMENT OF MATHEMATICS
COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Diploma/Degree/Honors)		**Semester - III**	**Session:2024-2025**
1	Course Code	**MASE-01**	
2	Course Title	Advanced Calculus	
3	Course Type	Discipline Specific Elective (DSE)	
4	Pre-requisite (if any)	Basic idea of elementary differential and integral calculus	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Calculate the limit and examine the continuity and understand the concepts of limit , continuity and differentiability of functions of more than one variable with geometrical interpretation. ➢ To Understand the concepts of mean value theorems with their applications . ➢ To understand the concept of maxima and minima for functions of two and three variables with their uses and techniques ➢ Understand conceptual variations while advancing from one variable to severalvariables in calculus. ➢ Understand the concept of integration of functions of two and three variables and their evaluation technique with emphasis on beta and gamma functions .	
6	Credit Value	**4 C**	1Credit = 15 hours- Learning and observation
7	Total Marks	Maximum Marks : 100	Minimum Passing Marks:40

Part B: Content of the Course		
Total no of teaching – learning period =60 Periods (60 Hours)		
UNIT	**Topics**	**No of Periods**
I	Limit and continuity of function of two and three variables. Mean value theorems of function of two variables- First mean value theorem and taylor's theorem. Partial Differentiation and Euler's theorem on homogeneous functions, Change of variables.	**15**
II	Partial Derivation and differentiability of function of two variables. Schwartz's theorem, Young's theorem, Implicit function theorem. Fourier series, Fourier expansion of piece wise monotonic function.	**15**
III	Jacobians , Maxima, Minima and saddle points of function of two variables. Lagrange's multipliers method. Envelopes, Evolutes	**15**
IV	Beta and Gamma function. Double and triple integrals .Dirichelet's integrals. Change of order of integration.	**15**

(Dr. S. Dashpute) (Dr. Omkar Lal Shrivastava) (Dr. P. K. Sahu)

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended-

1. Gorakh Prasad (2016). Differential Calculus (19th edition). Pothishala Pvt. Ltd.
2. Mathematical Analysis, S.C. malik and S. Arora, New age international,Delhi
3. Howard Anton, I. Bivens & Stephan Davis (2016). Calculus (10th edition).Wiley India.
4. Gabriel Klambauer (1986). Aspects of Calculus. Springer-Verlag.
5. Wieslaw Krawcewicz & Bindhyachal Rai (2003). Calculus with Maple Labs.
6. Principles of Mathematical analysis, W.Rudin,McGraw Hill Publication
7. Jerrold Marsden, Anthony J. Tromba & Alan Weinstein (2009). Basic
8. James Stewart (2012). Multivariable Calculus (7th edition). Brooks/Cole. Cengage.

E-resources: https://onlinecourses.nptel.ac.in
https://epgp.inflibnet.aci.in
https://swayam.gov.inhttps://www.mooc.org

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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

Continuous Internal Assessment (CIA) (Conducted by course teacher)	Test /Quiz – 20+20 Marks Assignment/Seminar- 10 Marks	Better marks out of two test/quiz + obtained marks in Assignment shall be considered against 30 marks
End Semester Examination (ESE)	**Two Section**-A&B Section-A: Q1.Objective- 10x1=10 marks Q2. Short answer type question-5x4=20marks Section-B: Descriptive answer type question, 1 out of 2 from each unit- 10x4= 40 Marks	

Name and signature of convener & members of CBOS-

FOUR YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Diploma/ Degree/ Honors)	Semester: III	Session: 2024-25

1	**Course Code**	**PHSC-03T**	
2	**Course Title**	**Heat and Thermodynamics**	
3	**Course Type**	**Discipline Specific Course**	
4	**Pre-requisite (if any)**	**As per Program**	
5	**Course Learning Outcomes (CLO)**	After going through the course, the student should be able to: • Demonstrate a deep comprehension of the fundamental principles of thermodynamics, including concepts such as energy, entropy and laws of thermodynamics. • Apply the laws of thermodynamics to analyze and solve problems related with energy transfer, heat engines, refrigeration system and other thermodynamic processes. • Analyze basic aspects of kinetic theory and transport phenomenon in gases.	
6	**Credit Value**	**03 Credits**	**1 Credit= 15 Hours for Learning &Observation**
7	**Total Marks**	**Maximum Marks: 100**	**Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

TotalNo.of Teaching–learning Periods (01 Hr. per period) - 45 Periods (45 Hours)

Unit	Topics (Course contents)	No. of Period
I	**Historical background:** A brief historical background of thermodynamics and statistical physics in the context of India and Indian culture, Contribution of S. N. Bose in Statistical mechanics. **Laws of Thermodynamics:** Thermodynamic Description of system, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, various Thermodynamical Processes, Work Done during Isothermal and Adiabatic Processes, Reversible & irreversible processes. Second law of thermodynamics & Entropy, Carnot's cycle, Carnot's theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics.	12
II	**Thermodynamic Potentials:** Internal Energy, Enthalpy, Helmholtz Free Energy and Gibbs function. Maxwell's relations & applications, Clausius- Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations, Thermodynamic energy equation- change in internal energy of an ideal and Vander Waal's gas, Joule-Thompson Effect, Cooling by adiabatic demagnetization.	11
III	**Kinetic Theory of Gases:** Maxwellian distribution of speeds in an ideal gas: distribution of speeds and velocities, experimental verification, distinction between mean, rms and most probable speed values, Molecular Collision and Mean Free Path. **Transport Phenomena in gases**: Viscosity, Conduction and Diffusion, Law of equipartition of energy.	11
IV	**Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of Energy Density, Stefan Boltzmann Law, Newton's law of cooling from Stefan Boltzmann's law. Wien's displacement law and Rayleigh-Jeans Law (Only qualitative). Planck's radiation Law, Deduction of Wien's distribution law and Rayleigh- Jeans Law from Planck's law. Experimental verification of Planck's radiation law.	11

Keywords:	Zeroth and First Law of Thermodynamics, Second Law of Thermodynamics,Entropy, Thermodynamic Potentials, Maxwell's Thermodynamic RelationsKinetic Theory of Gases, Distribution of Velocities, Molecular Collisions, Real Gases, Laws of radiation

SignatureofConvener&Members (CBoS) :

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books

1. Heat and Thermodynamics: Singhal, Agrawal and Satya Prakash, Pragati Prakashan 1984
2. Physics (Part-2): Editor, Prof. B.P.Chandra, M.P. Hindi Granth Academy
3. Unified Physics –II ,R.P.Goyal, Shivlal Agrawal &Sons
4. Unified Physics –II. NovbodhPrakashan

Reference Books

1. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears&G.L.Salinger. 1988, Narosa
2. Energy Science in Vedas: A Treatise on Vedic Thermodynamics and Free Energy (Exploring Lost Science and Technology in Vedas), Ramesh Kumar Mineria; Priya Veda Publications

Online Resources (e-books/ learning portals/ other e-resources)

1. Basics of thermodynamics ***https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8***
2. Thermodynamics ***https://www.youtube.com/watch?v=E9cOAMhFUz0***
3. Second law of thermodynamics ***https://www.youtube.com/watch?v=F_flGosPY8o***
4. ***NPTEL Online Lectures: https://archive.nptel.ac.in/courses/115/105/115105129/***
5. ***https://archive.nptel.ac.in/courses/115/106/115106090/***
6. ***https://bsc.hcverma.in/course/penopcyc***
7. Vedic Science and Thermodynamics :***https://www.puranavedas.com/vedic-physics/***
8. ***https://www.amazon.in/Vedic-Physics-Raja-Ram-Mohan/dp/0968412009?asin=1988207045&revisionId=&format=4&depth=2***
9. https://ia903100.us.archive.org/3/items/wholelottabooks/The%20Astronomical%20Code%20of%20the%20Rgveda%20-%20Shubash%20Kak.pdf

PART – D: Assessment and Evaluation

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

Continuous Internal Assessment (CIA): (By course teacher)	Internal Test/ Quiz (2): **20÷20** Assignment/ Seminar (1): **10** Total Marks: **30**	Better marks out of the two Test / Quiz+ marks obtained 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,**1out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

10/6/24

FOUR YEARS UNDERGRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program:Bachelor in Science (Diploma/ Degree/ Honors)		Semester: III	Session: 2024-25
1	Course Code	PHSC- 03P	
2	Course Title	Heat and Thermodynamics	
3	Course Type	Discipline Core Course	
4	Pre-requisite (if any)	As per Program	
5	Course Learning Outcomes (CLO)	➢ Lab Proficiency: Thermometers, pressure gauges, calorimeters, heat transfer apparatus, experimental setup, data acquisition. ➢ Hands-on Learning**: Heat transfer, work done, entropy, phase transitions, experiments. ➢ Data Analysis: Experimental data, theoretical discrepancies, analysis. ➢ Predictive Skills: Thermodynamic behavior, varying conditions, experimentation. ➢ Theory-Practice Integration: Theoretical knowledge, practical lab work, synthesis, applications.	
6	Credit Value	01 Credit	1 Credit = 30 HoursLaboratory Work
7	Total Marks	Maximum Marks: 50	Minimum Pass Marks: 20

PART – B: CONTENT OF THE COURSE

TotalNo.of learning-Training/performance Periods -30 Periods (30 Hours)

Sr. No.	Objects (At least 10 of the following or related Experiments)	No. of Periods
1	To determine the thermal conductivity of a non-conducting material by Lee's disc method.	30
2	To study the variation of thermo emf across two junctions of a thermocouple with temperature.	
3	To verify Newton's law of cooling.	
4	To determine the temperature co-efficient of resistance by Platinum resistance thermometer.	
5	To determine the coefficient of thermal conductivity(k) of a rubber tube.	
6	To study the heat efficiency of an electric kettle with varying voltage.	
7	To determine the ratio of specific heat at constant pressure and constant volume (γ=Cp/Cv) of air Clement and Desorme's method.	
8	To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.	
9	To study the variation of thermos-Emf of thermos couple with Difference of Temperature of its Two Junctions.	
10	To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.	
11	Measurement of Planck's constant using black body radiation.	
12	To determine Stefan's Constant.	

Keywords:	Thermal conductivity, Thermocouple, Newton's law of cooling, Temperature coefficient of resistance, Heat efficiency, Specific heat ratio, Mechanical equivalent of heat, Planck's constant

SignatureofConvener&Members (CBoS) :

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PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended-

1. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
5. Unified Practical Physics B.Sc II : R P Goyal, Shivlal Agrawal &Sons Publications

Reference Books Recommended-

1. Practical Physics by C.L. Arora
2. Practical Physics by S.L. Gupta and Vijay Kumar
3. Advanced Practical Physics for Students by B.L. Worsnop and H.T. Flint

Online Resources (e-books/ learning portals/ other e-resources)

Link for e-Books for Physics Practicaland Virtual labs

1. Thermal Physics and Statistical Mechanics: Laboratory Collectionhttps://egyankosh.ac.in/handle/123456789/67450
2. Virtual Lab :https://vlab.amrita.edu/index.php?sub=1&brch=194
3. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=802&cnt=1
4. https://vlab.amrita.edu/index.php?sub=1&brch=194&sim=801&cnt=4
5. https://srmap.edu.in/seas/physics-virtual-lab/
6. https://sites.google.com/view/vlab-bnmitmech/home/heat-transfer-lab
   https://www.pbslearningmedia.org/resource/lsps07-sci-phys-thermalenergy/thermal-energy-transfer/#.WdJiOJIrLIU

PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:
Maximum Marks: 50 Marks
Continuous Internal Assessment(CIA):15 Marks
EndSemester Exam(ESE):35 Marks

Continuous InternalAssessment(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 **+Marks** obtained in Assignment shall be considered against **15** Marks
End Semester Exam (ESE):	**Laboratory Performance: On spot Assessment** **Performed the Task based on lab. work - 20 Marks** **Spotting based on tools & technology (written) – 10 Marks** **Viva-voce (based on principle/technology) - 05 Marks**	**Managed by Course teacher as per lab. status**

Name and Signature of Convener & Members of CBoS:

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

PART-A: INTRODUCTION

Program : Bachelor in Science *(Diploma / Degree/Honors)*	Semester - III	Session: 2024-2025

1	**Course Code**	**PHSE-01**
2	**Course Title**	**Introduction to Statistical Mechanics**
3	**Course Type**	**Discipline Specific Elective**
4	**Pre-requisite** (if, any)	**As per Program**
5	**Course Learning. Outcomes(CLO)**	➢ Differentiate between macrostate and microstate and calculate their numbers ➢ Comprehend the concept of ensembles and its requirement in study of physical phenomenon ➢ Correlate and compare the classical and quantum statistical distribution laws. ➢ Apply concepts of statistical distribution laws for different physical systems.
6	**Credit Value**	**4 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) – 60 Periods (60 Hours)

Unit	Topics (Course Contents)	No. of Period
I	**Maxwellian Distribution of Speeds In An Ideal Gas**: Distribution of speeds and velocity, experimental verification, distinction between mean, rms and most probable speeds, Doppler broadening of spectral lines, transport phenomena in gases: molecular collision, collision cross section, estimates of molecular diameter and mean free path; transport of mass , momentum and energy and inter-relationship, dependence on temperature and pressure. **Behaviour of Real Gases :**deviation from ideal gas equation, the Virial equation, Andrew's experiment on CO_2 gas; critical constants.	15
II	**Macrostate & Microstate** Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. **Concept of Ensemble:** Concept of Gibb's ensemble, postulate of ensemble average, Micro Canonical, Canonical & Grand Canonical ensembles. Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation. Phase space, Phase trajectory, Volume element in phase space, Quantization of phase space and number of accessible microstates for free particle in 1D, free particle in 3D.	15

III	**Transition to quantum statistics:** *h* as a natural constant and its implications, cases of particle in 1D and 1Dimensional harmonic oscillator, **Quantum Statistical Distribution Laws:** In-distinguishability of particles and its consequences, Bose-Einstein & Fermi Dirac statistics. Comparison of statistical distribution laws and their physical significance. Canonical Distribution Law: Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, Proof of Equipartition Theorem (Law of Equipartition of energy) and relation between Partition function and Thermodynamic potentials.	**15**
IV	**Bose-Einstein Distribution Law and its Applications:** Bose-Einstein Statistics: Heat capacity, Bose Einstein condensation, Radiation as a photon gas, Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law **Fermi-Dirac Distribution Law and its Applications:** Free electrons in a metal, Definition of Fermi energy, Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero and concept of Density of States, Specific Heat of Metals (Density of Orbitals).	**15**
Keywords	Macrostate & Microstate, ensemble, distribution laws, Bose-Einstein Statistics, Fermi-Dirac Statistics	

Name and Signature of Convener & Members of CBoS:

10/6/24

PART–C:LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Unified Physics –II, R P Goyal, Shivlal Agrawal & Sons Publication
2. Unified Physics-II, Yugbodh Prakashan
3. Unified Physics-II, Navbodh Prakashan

Reference Books Recommended–

1. F. Reif, "Statistical Physics (In SI Units): Berkeley Physics Course Vol 5", McGraw Hill, 2017
2. B.B. Laud, "Fundamentals of Statistical Mechanics", New Age International Private Limited, 2020
3. B.K. Agarwal, M. Eisner, "Statistical Mechanics", New Age International Private Limited, 2007

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

1. MIT Open Learning - Massachusetts Institute of Technology, https://ocw.mit.edu/courses/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/
2. National Programme on Technology Enhanced Learning (NPTEL), https://archive.nptel.ac.in/courses/115/103/115103113/,
3. https://onlinecourses.nptel.ac.in/noc19_ph10/preview,
4. https://archive.nptel.ac.in/courses/115/106/115106126/
5. Uttar Pradesh Higher Education Digital Library, http://heecontent.upsdc.gov.in/SearchContent.aspx
6. Swayam Prabha - DTH Channel, https://www.swayamprabha.gov.in/index.php/program/current_he/8

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 =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**	**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 YEARS UNDERGRADUATE PROGRAM (2024-28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART – A: INTRODUCTION

Program: Bachelor in Science (Certificate/ Diploma/ Degree/ Honors)	Semester: I/ III/ V	Session: 2024-25

1	Course Code	**PHVAC-01**	
2	Course Title	**Renewable Energy and Energy Harvesting**	
3	Course Type	**Value Addition Course**	
4	Pre-requisite (if any)	**As per Program**	
5	Course Learning Outcomes (CLO)	Objective of the course is to impart students; the knowledge of renewable energy and they are expected to learn about: ➢ Energy crisis at national and international scenario. ➢ Renewable sources of energy and their importance. ➢ Availability of renewable energy resources in India. ➢ Knowledge about energy harvesting technology.	
6	Credit Value	**02 Credits**	**1 Credit = 15 Hours- Learning & Observation**
7	Total Marks	**Maximum 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	No. of Period
I	**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. Limitations of non-conventional energy resources. Environmental aspect of energy, World energy status, Energy scenario in India. **Geo thermal Energy**: Geothermal Resources, Geo thermal Technologies.	07
II	**Solar energy:** Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, sun tracking systems. **Hydro Energy**: Hydro power resources, hydro power technologies, environmental impact of hydro power sources.	08
III	**Biomass energy:** Biomass resources, Biomass conversion technology, biogas generation, factors affecting bio-digestion, working of biogas plant (with block diagram), biogas from plant waste, biomass energy programme in India, Biodiesel production from non-edible oil seeds. **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.	08
IV	**Wind Energy harvesting**: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines. grid interconnection topologies. **Piezoelectric Energy harvesting:** Introduction, Physics and characteristics of piezoelectric effect, piezoelectric materials, Piezoelectric Energy harvesting applications.	07
Keywords:	Fossil fuel, Renewable energy sources, Solar energy, Biomass energy, Electromagnetic Energy Harvesting, Piezoelectric Energy harvesting.	

Signature of Convener & Members (CBoS):

PART – C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended-

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

Reference Books Recommended-

1. Non-Conventional Energy Resources by B.H. Khan
2. Renewable Energy Sources and Emerging Technologies by D.P. Kothari, K.C. Singal, and Rakesh Ranjan
3. Solar Energy: Fundamentals, Design, Modelling and Applications by G.N. Tiwari
4. Hydropower Development in India: A Sector Assessment by Pradeep Chaturvedi
5. Biomass Conversion: The Interface of Biotechnology, Chemistry and Materials Science by Samir K. Khanal, edited by B.C. Meikap and P.K. Bhattacharya
6. Ocean Energy: Technology, Environmental Impact and Renewable Energy by Pranav Kumar and T. Balaji
7. Wind Energy: Theory and Practice by S. Rao and Dr. B.B. Parulekar
8. Piezoelectric Materials and Devices: Applications in Engineering and Medical Sciences by Arun Ghosh

Online Resources (e-books/ learning portals/ other e-resources)

1. http://en.wikipedia.org/wiki/Renewable_energy
2. Renewable Energy Engineering: Solar, Wind And Biomass Energy Systems - Course (nptel.ac.in)
3. Technologies For Clean And Renewable Energy Production – NPTEL+
4. NPTEL :: Mechanical Engineering - NOC:Selection Of Nanomaterials For Energy Harvesting And Storage Application
5. Wind energy Labs : Mechanical Engineering : Amrita Vishwa Vidyapeetham Virtual Lab
6. Virtual Labs (vlabs.ac.in)
7. https://youtu.be/uY3x7Tycyps

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 + marks obtained in Assignment shall be considered against **15** Marks.
End Semester Examination (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.,**1 out of 2** from each unit- **4x05 =20 Marks**	

Signature of Convener & Members (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. Ujjwala Sayde

Dr. Shubha Diwan 11/6/24

(Dr. Keshav Kant Shahi)

Dr. Pramod Maurya

Sanjaan 11/06/24

(Dr. Sanjaan Bhagat)

Neha Behar (11/6/24)

(Dr. Neha Behar)

Shivthar 11/6/24

Dr. Shivani Sha

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)

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Dr. Vijayalaxmi

Diwan 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

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