SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

[M.Sc. Defence Science] Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2T01NCDES01**	Elements of Physical Sciences	4-0-1	**120**	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1:

Analyze classical and relativistic mechanical systems by integrating vector mechanics, conservation laws, and the principles of Special Theory of Relativity and General Theory of Relativity to interpret physical phenomena.

CLO2:

Evaluate thermodynamic systems and statistical models by applying laws of heat, entropy, and kinetic theory to assess energy transformations and irreversibility in real-world processes.

CLO3:

Synthesize electromagnetic field behavior using Maxwell's Equations to model wave propagation, radiation, and plasma interactions in advanced physical systems.

CLO4:

Design and assess semiconductor devices and optoelectronic systems by applying principles of charge transport, energy band theory, and photonic interactions for technological applications.

CLO5:

Integrate and construct interdisciplinary models combining biophysics and molecular structures to interpret protein and nucleic acid behavior using computational and theoretical approaches.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction and Measurements; Vectors – Kinematics- Newton's Laws of Motion - Equilibrium - Uniform Circular Motion- Gravitationand Satellites. Energy, Momentum Conservations. Rotational Motion-Elasticity, Simple Harmonic Motion-Wave Motion – Fluids. The Principle of Galilean Relativity-The Michelson–Morley ExperimentEinstein's Principle of Relativity-Consequences of the Special Theory of Relativity-The Lorentz Transformation-Equations. Relativistic Linear Momentum and the Relativistic Form of Newton's Laws-Relativistic EnergyEquivalence of Mass and Energy-Relativity and Electromagnetism- The General Theory of Relativity.	CL, Seminar, RP	CLO1
II	Temperature and Heat: Thermal Expansion and the Gas Laws , Heat Transfer, Thermodynamics, The Kinetic Theory of Gases, Molecular Model of an Ideal Gas, Molar Specific Heat of an Ideal Gas, Adiabatic Processes for an Ideal Gas, The Equipartition of Energy, The Boltzmann Distribution Law, Distribution of Molecular Speeds, Mean Free Path. Heat Engines and the Second Law of Thermodynamics: Reversible and	CL, ICT, PBL	CLO2

	Irreversible Processes-The Carnot Engine-Gasoline and Diesel Engines-Heat Pumps and Refrigerators. Entropy-Entropy Changes in Irreversible Processes-Entropy on a Microscopic Scale.		
III	Applications of Electrostatics: Applications Involving Charged Particles Moving in a Magnetic Field-The Hall Effect, The Biot–Savart Law, The Magnetic Force Between two Parallel Conductors, Ampère's Law, The Magnetic Field of a Solenoid, Magnetic Flux, Gauss's Law in Magnetism, Displacement Current and General Form of Ampère's Law, Magnetism in Matter-The Magnetic Field of the Earth, Faraday's Law of Induction-Induced emf and Electric Fields-Generators and Motors-Eddy Currents. Maxwell's Equations: Maxwell's Equations and Hertz's Discoveries-Plane Electromagnetic Waves- Energy Carried by Electromagnetic Waves Momentum and Radiation Pressure-Radiation from an Infinite Current Sheet, Production of Electromagnetic Waves by an Antenna-The Spectrum of Electromagnetic Waves. Brief review of plasma state of matter, Plane waves in tenuous plasma.	CL, Seminar SDL	CLO3
IV	Semiconductor Physics and Bio-physics: Introduction to semiconductors, energy bands and charge carriers; p -n junction diode; bipolar junction transistors- construction, operation; Photo sensitive devices: photodiodes, photoconductive cells, solar cells, phototransistors, light-activated SCR. Introduction to Molecular modeling: Building protein structure (amino acids and the primary structure, the peptide bond and secondary structure, etc.), nucleic acid structure (the chemical structure, the double helical structure of DNA, etc.).	CL, ICT, RP	CLO4, CLO5

- **(*) Learning Pedagogies/Methods**

  Notes:

  (1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

  (2) Acronyms/abbreviations of the terms can be placed in the above table.

  (a) Classroom Lecture (CL)
  (b) Seminars (Student-led and Faculty-moderated)
  (c) Case-Based Learning (CBL)
  (d) Micro-Projects/Mini Research Tasks
  (e) Industrial Visit/Field Visit/Institutional Visit
  (f) Problem-Based Learning (PBL)
  (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
  (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
  (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
  (j) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
  (k) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
  (l) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
  (m) Inquiry-Based Learning
  (n) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment

a. Internal Formative assessment [30Marks]

(a) Assignment, Self-learning and Terms work
(b) Seminar/Presentation
(c) Quiz
(d) Attendance

b. Internal Summative Assessment [20Marks]

(a) Mid-term tests [20Marks]
(b) End of Term Examination
(c) Laboratory performance
(d) Viva-voce

(B) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse& above (A)	
I	**CLO1**	30	2	3	7	12
II	**CLO2**	30	2	3	7	12
III	**CLO3**	30	2	3	9	14
IV	**CLO4, CLO5**	30	2	3	7	12
		120	**8**	**12**	**30**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity	50%
2	End-Semester Examination	Written Exam	50%

(C) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3	3	2	2	2	1	1	-	-
CLO2	3	2	3	3	2	2	1	1	-	-
CLO3	3	3	3	3	3	2	3	2	1	-
CLO4	3	3	2	3	2	2	3	2	1	-
CLO5	2	2	2	2	3	3	3	2	2	1

[M.Sc. Defence Science] Semester-I

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Fundamentals of College Physics	Dr. Peter J. Nolan	1993	Pearson Custom Publishing
2	Fundamentals of Physics	David Halliday, Robert Resnick, Jearl Walker	8th Edition, 2007	John Wiley & Sons
3	Biophysics	V. Pattabhi, N. Gautham	2nd Edition, 2017	Narosa Publishing House
4	Solid State Electronic Devices	B. G. Streetman, S. Banerjee	6th Edition, 2005	Pearson / PHI
5	Electronic Devices and Circuit Theory	R. L. Boylestad, L. Nashelsky	10th Edition, 2008	Pearson Education
6	Classical Mechanics	Herbert Goldstein, Charles Poole, John Safko	3rd Edition, 2001	Pearson / Addison Wesley
7	Introduction to Electrodynamics	David J. Griffiths	3rd Edition, 1999	PHI Learning / Prentice Hall
8	Classical Electromagnetic Theory	J. Vanderlinde	2nd Edition, 2004	John Wiley & Sons

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL course on Classical Mechanics (covers Newtonian mechanics, oscillations, waves)	https://nptel.ac.in/courses/115106061
2	NPTEL course on Special Theory of Relativity and Electrodynamics	https://nptel.ac.in/courses/115101004
3	NPTEL course on Thermodynamics and Statistical Mechanics	https://nptel.ac.in/courses/112106220
4	NPTEL course on Electromagnetic Fields and Waves (Maxwell's Equations, EM waves)	https://nptel.ac.in/courses/108106073
5	NPTEL course on Semiconductor Devices and Circuits	https://nptel.ac.in/courses/117106087

[M.Sc. Defence Science] Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2T01NCDES02**	Elements of Chemical Sciences	4-0-1	**120**	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1:
Analyze atomic structure and electronic configurations using quantum mechanical principles to rationalize periodic trends and bonding behavior.

CLO2:
Evaluate chemical bonding theories (VBT, VSEPR, hybridization) to predict and justify molecular geometry, stability, and reactivity of inorganic and organic systems.

CLO3:
Integrate and critique concepts of structure, bonding, and reactive intermediates to propose mechanisms for complex organic reactions using experimental evidence.

CLO4:
Apply and analyze thermodynamic, kinetic, and statistical models to interpret physical properties and predict reaction feasibility and rates in chemical systems.

CLO5:
Design and evaluate theoretical and experimental approaches using principles of solid state, phase equilibria, and statistical thermodynamics to solve advanced chemical problems.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	**Inorganic Chemistry** Atomic structure: de Broglie matter waves, Heisenberg Uncertainty principle, atomic orbitals, Aufbau and Pauli exclusion principles, Hund`s multiplicity rule, electronic configuration of elements: Chemical Bonding: Covalent bond – valence bond theory and its limitations, types of hybridization and shapes of simple inorganic molecules and ions, VSEPR theory to NH_3, H_3O+, SF_4 and H_2) etc. bond strength and bond energy, percentage of ionic character.	CL, Seminar, RP	CLO1
II	**Organic Chemistry** Structure and bonding: Hybridization, bond length and angles, bond energy, localized and delocalized chemical bonds, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyper conjugation, aromaticity Mechanism organic reactions: Electrophiles and nucleophiles, types of organic reactions, reactive intermediates – carbocations, carbanions, free radicals, carbenes, arynes and nitriles (with examples), methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic studies).	CL, Seminar, ICT, PBL	CLO2
III	**Physical Chemistry** Gaseous state: Postulates of kinetic theory of gases, van der Waals equation of state, ideal behaviour and deviations Liquid state:	CL, Seminar SDL	CLO3

	intermolecular interactions, structure of liquids Solid state: Definition of lattice, unit cell, space lattice, x-ray diffraction by crystals and Braggs equation Chemical Kinetics: Rate laws and rate equations for first, second and third order equations, Hal and mean life, activation energy and Arrhenius equation, determination of order of reaction, characteristics of catalyzed reactions.		
IV	**Thermodynamics** Review of basics of thermodynamics including the laws of thermodynamics, Heats of summation- Hess law, Kirchoff equation, Clausi-Clapeyron – phase diagrams and Carnot cycles, open hydrostatic system and Gibbs- Duhem equation, Statistical thermodynamics – Canonical and grand Canonical ensemble, partition function and derivation of thermodynamics functions, Statistical distribution functions- Maxwell- Boltzman, Fermi- Dirac and Bose-Einstein and Applications.	CL, ICT, RP	CLO4, CLO5

- **(*) Learning Pedagogies/Methods**

  Notes:
  (3) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.
  (4) Acronyms/abbreviations of the terms can be placed in the above table.
  (o) Classroom Lecture (CL)
  (p) Seminars (Student-led and Faculty-moderated)
  (q) Case-Based Learning (CBL)
  (r) Micro-Projects/Mini Research Tasks
  (s) Industrial Visit/Field Visit/Institutional Visit
  (t) Problem-Based Learning (PBL)
  (u) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
  (v) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
  (w) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
  (x) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
  (y) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
  (z) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
  (aa) Inquiry-Based Learning
  (bb) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

  (D) Internal Assessment

  a. Internal Formative assessment [30Marks]

  (e) Assignment, Self-learning and Terms work
  (f) Seminar/Presentation
  (g) Quiz
  (h) Attendance

b. Internal Summative Assessment [20Marks]

(e) Mid-term tests [20Marks]
(f) End of Term Examination
(g) Laboratory performance
(h) Viva-voce

(E) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse& above (A)	
I	**CLO1**	30	2	3	7	12
II	**CLO2**	30	2	3	7	12
III	**CLO3**	30	2	3	9	14
IV	**CLO4, CLO5**	30	2	3	7	12
		120	**8**	**12**	**30**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity	50%
2	End-Semester Examination	Written Exam	50%

(F) CLOs – PLOs Matrix

CLOs	PLOs									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	2	3	1	2	3	1	-	-
CLO2	3	2	2	3	2	2	2	1	-	-
CLO3	2	3	3	3	3	3	2	2	1	1
CLO4	3	3	3	3	2	2	2	1	-	-
CLO5	3	3	3	3	3	3	3	2	1	1

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Basic Inorganic Chemistry	F. A. Cotton, G. Wilkinson, P. L. Gaus	3rd Edition, 1995	Wiley
2	Concise Inorganic Chemistry	J. D. Lee	5th Edition, 1996	ELBS / Wiley
3	Inorganic Chemistry	D. F. Shriver, P. W. Atkins	5th Edition, 2010	Oxford University Press
4	Organic Chemistry	Morrison & Boyd	7th Edition, 2010	Prentice Hall
5	Organic Chemistry (Vol. I–III)	S. M. Mukherjee, S. P. Singh, R. P. Kapoor	2007	Wiley Eastern Ltd.
6	Fundamentals of Organic Chemistry	T. W. Graham Solomons, Craig Fryhle	11th Edition, 2013	Wiley
7	Physical Chemistry	G. M. Barrow	International Student Edition, 1996	McGraw-Hill
8	University General Chemistry	C. N. R. Rao	2009	Macmillan
9	Physical Chemistry	R. A. Alberty, R. J. Silbey	3rd Edition, 2001	Wiley
10	The Elements of Physical Chemistry	P. W. Atkins, Julio de Paula	6th Edition, 2013	Oxford University Press

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL course on Basics in Inorganic Chemistry	https://nptel.ac.in/courses/104101121
2	NPTEL course on Concepts of Chemistry for Engineering	https://onlinecourses.nptel.ac.in/noc25_cy48/preview
3	NPTEL course on Introduction to Chemical Thermodynamics and Kinetics	http://www.digimat.in/nptel/courses/video/104106089/L01.html

[M.Sc. Defence Science] Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2T01NCDES03**	Mathematical & Statistical Tools	4-0-1	**120**	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1:
Apply advanced concepts of calculus, vector algebra, matrices, and differential equations to formulate and analyze mathematical models arising in physical and scientific systems.

CLO2:
Evaluate the stability, Eigen structure, and analytical solutions of ordinary and partial differential equations using higher-order mathematical techniques.

CLO3:
Develop and implement numerical methods for solving differential equations and assessing computational errors in scientific problems.

CLO4:
Analyze and interpret statistical data using probability distributions, descriptive statistics, and inferential statistical methods for scientific decision-making.

CLO5:
Critically assess and solve complex multidisciplinary problems by integrating mathematical reasoning, statistical inference, and computational approaches.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	A Calculus refresher- functions and their derivatives – derivative as rate of change – Higher Order Derivatives - Maxima and Minima – Integration - Partial Derivatives – Taylor series - Gradient, Divergence and Curl - Hessian- Maxima and Minima. Vectors in Rn and matrices- algebra of matrices- inverse of a matrix- determinant and trace- eigen values and eigen vectors- projections and orthogonal matrices.	CL, Seminar, RP	CLO1
II	Ordinary differential equations- linear equations of first and second order – systems of linear differential equations- stability of solutions of linear systems of ODE- Legendre, Hermite and Bessel equations and polynomials. Partial differential equations of science and method of reparation of variables-Applications.	CL, Seminar, ICT, PBL	CLO2
III	Numerical Analysis- Newton Method for implicit equation, Eular's method and Rumge-Kutta method for ordinary differential equations – Methods of Elementary Error Analysis. Collection and classification of data- frequency table- graphical representations of data- measures of central tendancy: mean, median, mode- measures of dispersion: variance standard deviation, coefficient of	CL, Seminar SDL	CLO3

	variation.		

IV	Random Variables- probability- joint, marginal and conditional probability – discrete and continuous random variables – probability distribution functions- Expectation and Moments – Binomial, Poisson and Normal distributions- a compendium of some other distribution functions. Testing of hypotheses – goodness of fit tests- chi-square test- tests of significance- one sample tests for mean- z test and t-test – two sample tests for means and variance.	CL, ICT, RP	CLO4, CLO5

- **(*) Learning Pedagogies/Methods**

  Notes:

  (5) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

  (6) Acronyms/abbreviations of the terms can be placed in the above table.

  (cc) Classroom Lecture (CL)
  (dd) Seminars (Student-led and Faculty-moderated)
  (ee) Case-Based Learning (CBL)
  (ff) Micro-Projects/Mini Research Tasks
  (gg) Industrial Visit/Field Visit/Institutional Visit
  (hh) Problem-Based Learning (PBL)
  (ii) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
  (jj) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
  (kk) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
  (ll) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
  (mm) ICT-Enabled Learning (LMS-based Tasks, Digital Resources,Virtual Labs/Webinars)
  (nn) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
  (oo) Inquiry-Based Learning
  (pp) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(G) Internal Assessment

a. Internal Formative assessment [30Marks]

(i) Assignment, Self-learning and Terms work
(j) Seminar/Presentation
(k) Quiz
(l) Attendance

b. Internal Summative Assessment [20Marks]

(i) Mid-term tests [20Marks]
(j) End of Term Examination
(k) Laboratory performance

(l) Viva-voce

(H) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse& above (A)	
I	**CLO1**	30	2	3	7	12
II	**CLO2**	30	2	3	7	12
III	**CLO3**	30	2	3	9	14
IV	**CLO4, CLO5**	30	2	3	7	12
		120	**8**	**12**	**30**	**50**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity	50%
2	End-Semester Examination	Written Exam	50%

(I) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	3	2	3	2	2	1	-	-
CLO2	3	3	3	3	3	2	2	1	-	-
CLO3	2	3	3	2	3	2	3	2	1	-
CLO4	2	3	3	3	2	3	3	3	1	1
CLO5	3	3	3	3	3	3	3	3	2	2

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Introduction to Geochemical Modeling	Francis Albarède	1st Edition, 1995	Cambridge University Press
2	Higher Engineering Mathematics	B. S. Grewal	44th Edition, 2023	Khanna Publishers
3	Statistics	David Freedman, Robert Pisani, Roger Purves	4th Edition, 2007	W. W. Norton & Company

- **Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL course on Basic Calculus	https://nptel.ac.in/courses/111106146
2	NPTEL course on Ordinary Differential Equations and Applications	https://nptel.ac.in/courses/111108081
3	NPTEL course on Numerical Analysis	https://nptel.ac.in/courses/111106101
4	NPTEL course on Probability and Statistics	https://onlinecourses.nptel.ac.in/noc21_ma74/preview

[M.Sc. Defence Science] Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2T01NCDES04**	Practical based on P2T01NCDES01 & P2T01NCDES02	0-4-0	**120**	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1:
Analyse physical phenomena such as electron diffraction, radioactivity, and semiconductor energy gaps by interpreting experimental data and relating results to underlying quantum and solid-state theories.

CLO2:
Evaluate the performance and characteristics of advanced instrumentation, including Cathode Ray Oscilloscopes (CRO), Geiger Muller (GM) counters, and Ultrasonic Interferometers, to ensure precision and accuracy in physical measurements.

CLO3:
Synthesize complex digital systems using basic logic gates to design functional circuits like parity checkers, code converters, and adders, demonstrating an understanding of Boolean logic in computational hardware.

CLO4:
Investigate the chemical and optical properties of materials—such as polymerization kinetics, molecular dissociation (Ka), and optical activity—by applying volumetric, pH-metric, and polarimetric techniques.

CLO5:
Critically assess experimental errors, beam characteristics (for Lasers), and material purity (for metal complexes) to propose optimizations for laboratory methodologies and industrial material testing.

Unit	Course Content	Learning Pedagogies*	CLO(s)
	Any eight of the following: 1. Electron- diffraction: Analysis of electron diffraction pattern and determination of the Inter-planar distance of the crystal. 2. Phase Angle measurement by Cathode Ray Oscilloscope (CRO) and then to determine the unknown Capacitance/ Resistance/ Operating Frequency of the circuit. 3. Determination of the Energy Bandgap (Eg) of a Semiconductor by studying the reverse bias characteristics of diode at different temperatures. 4. Ultrasonic Interferometer.	Experiential Learning, Collaborative Learning, PBL, SDL	CLO1, CLO2, CLO3, CLO4, CLO5

	5. Geiger Muller (G.M.) Counter: To study the GM Characteristic to determine the operating voltage of the counter and then to study the absorption of beta rays through metals. 6. Simulation of radio activity: To determine the half-life of a radioactive material. 7. Logic Gates: Basic Logic gates and its applications as parity checker, Grey to BCD code converter, Half adder etc. 8. Laser beam Characteristics: To determine the basic parameters of a laser beam. 9. To determine the percentage of two optically active substances in a given Solution polarimetrically. 10. Determination of dissociation constant, Ka for aspirin by pH metry. 11. Emulsion polymerization of methyl methacrylate using free radical initiator. 12. Preparation of Nickel Ammonium sulphate and determine its %age purity by estimating Nickel volumetrically.		

- **(*) Learning Pedagogies/Methods**

  Notes:

  (7) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

  (8) Acronyms/abbreviations of the terms can be placed in the above table.

  (qq) Classroom Lecture (CL)
  (rr) Seminars (Student-led and Faculty-moderated)
  (ss) Case-Based Learning (CBL)
  (tt) Micro-Projects/Mini Research Tasks
  (uu) Industrial Visit/Field Visit/Institutional Visit
  (vv) Problem-Based Learning (PBL)
  (ww) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
  (xx) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
  (yy) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
  (zz) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
  (aaa) ICT-Enabled Learning (LMS-based Tasks, Digital Resources,Virtual Labs/Webinars)
  (bbb) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
  (ccc) Inquiry-Based Learning
  (ddd) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

  (J) Internal Assessment

  a. Internal Formative assessment [30Marks]

  (m) Practical performance
  (n) Journal preparation

(o) Viva voce
(p) Attendance

b. Internal Summative Assessment [20Marks]

(m) Mid-term tests [20Marks]
(n) End of Term Examination
(o) Laboratory performance
(p) Viva-voce

(K) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse& above (A)	
Practical 01 to 8	CLO1, CLO2, CLO3, CLO4, CLO5	120	5	10	35	50

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Practical performance, Journal preparation, Viva voce, Attendance	50%
2	End-Semester Examination	University Practical Examination	50%

(L) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	3	2	1	3	2	1	-	-
CLO2	2	2	2	3	2	2	3	1	1	-
CLO3	3	3	2	2	3	1	3	1	1	-
CLO4	2	2	2	3	2	3	2	2	-	-
CLO5	1	2	2	3	2	3	2	3	2	2

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2

Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Practical Physics	C.L. Arora	2024	S. Chand
2	Digital Principles and Applications	Leach & Malvino	9th Ed.	McGraw Hill
3	Advanced Practical Physics for Students	Worsnop & Flint	Recent	Littlehampton

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2T01NCDES05**	Practical based on P2T01NCDES03 & P2T01NCDES06	0-4-0	**120**	04

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1:
Organize and visualize raw environmental and geoscientific datasets (rainfall, temperature, mineralogy) by constructing frequency tables and histograms to identify patterns in central tendency and data distribution.

CLO2:
Validate theoretical probability models (such as the Poisson distribution) using experimental data from nuclear instrumentation (GM Counter) and determine physical constants like half-life through simulated radioactive decay.

CLO3:
Execute inferential statistical tests (t-tests) and dispersion analysis (variance, coefficient of variation) to determine significant differences between material properties and the consistency of seismic activity across regions.

CLO4:
Utilize global databases (NASA/BGI) to extract, plot, and interpret gravity anomalies, demonstrating a practical understanding of the physical deviations between the Geoid and Spheroid.

CLO5:
Apply computational methods to process historical Sea Surface Temperature (SST) data to calculate the Southern Oscillation Index (SOI), enabling the identification and prediction of El Niño and La Niña cycles.

Unit	Course Content	Learning Pedagogies*	CLO(s)
	1. Take a raw dataset (e.g., daily rainfall or temperature for a year) and construct a Frequency Table and Histogram. 2. Calculate the Mean, Median, and Mode of mineral concentration samples from different soil sites to identify the "average" composition. 3. Compare two different datasets (e.g., seismic activity in two regions) using Variance and Coefficient of Variation to	Experiential Learning, Collaborative Learning, PBL, SDL	CLO1, CLO2, CLO3, CLO4, CLO5

	determine which region has more consistent (less dispersed) data. 4. Use data from a GM Counter (from your previous practical list) to verify if the emission of alpha/beta particles follows a Poisson distribution. 5. Perform a Two-Sample t-Test to determine if there is a statistically significant difference between the mean hardness of two different metal alloys. 6. Simulated radioactive decay using for half-life calculation. 7. Use gravity data from an online database (like BGI or NASA) to plot "Gravity Anomalies" and Visualization of Geoid vs. Spheroid. 8. Use historical Sea Surface Temperature (SST) data from the NOAA website to plot the Southern Oscillation Index (SOI) and identify El Niño and La Niña years. 9. CAD-CAM -solid modelling, surface modelling and visualization etc.		

- **(*) Learning Pedagogies/Methods**

Notes:
(9) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.
(10) Acronyms/abbreviations of the terms can be placed in the above table.

(eee) Classroom Lecture (CL)
(fff) Seminars (Student-led and Faculty-moderated)
(ggg) Case-Based Learning (CBL)
(hhh) Micro-Projects/Mini Research Tasks
(iii) Industrial Visit/Field Visit/Institutional Visit
(jjj) Problem-Based Learning (PBL)
(kkk) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
(lll) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
(mmm) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
(nnn) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
(ooo) ICT-Enabled Learning (LMS-based Tasks, Digital Resources,Virtual Labs/Webinars)
(ppp) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
(qqq) Inquiry-Based Learning
(rrr) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(M) Internal Assessment

a. Internal Formative assessment [30Marks]

(q) Practical performance

(r) Journal preparation
(s) Viva voce
(t) Attendance

b. Internal Summative Assessment [20Marks]

(q) Mid-term tests [20Marks]
(r) End of Term Examination
(s) Laboratory performance
(t) Viva-voce

(N) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse& above (A)	
Practical 01 to 08	CLO1, CLO2, CLO3, CLO4, CLO5	120	5	10	35	50

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Practical performance, Journal preparation, Viva voce, Attendance	50%
2	End-Semester Examination	University Practical Examination	50%

(O) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	2	3	3	1	2	3	2	3	1	-
CLO2	3	2	3	3	2	2	3	2	-	1
CLO3	2	3	3	2	2	3	2	3	1	-
CLO4	3	3	3	3	2	2	3	2	-	-
CLO5	3	2	3	3	3	2	3	2	2	1

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3

Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Planet Earth: Cosmology, Geology, and the Evolution of Life and Environment	Cesare Emiliani	Low Priced Edition	Cambridge University Press
2	Introductory Methods of Numerical Analysis	S. S. Sastry	5th Edition	PHI Learning
3	Introduction to Probability and Statistics for Engineers and Scientists	Sheldon M. Ross	6th Edition	Academic Press
4	Numerical Recipes: The Art of Scientific Computing	W. H. Press, et al.	3rd Edition	Cambridge University Press
5	Fundamentals of Geophysics	William Lowrie	2nd Edition	Cambridge University Press
6	Statistics and Data Analysis in Geology	John C. Davis	3rd Edition	Wiley

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	**P2T01NCDES06**	Computer Aided Design (CAD) & Computer Aided Manufacturing (CAM)	2-0-0	**60**	02

- **Course Learning Outcomes (CLOs)**

On completion of this course, students will be able to:

CLO1: Analyze the mathematical foundations of computer graphics by implementing output primitives and applying 2-D transformations (translation, scaling, and rotation) within specified windowing and viewport coordinates.

CLO2: Utilize CAD software features to create, manipulate, and manage technical drawings and designs, demonstrating a professional understanding of the CAD workflow from concept to detailed object documentation.

CLO3: Develop complex 3-D representations by integrating wireframe, surface, and solid modeling techniques, ensuring the structural integrity of digital prototypes.

CLO4: Execute the assembly of individual parts into functional multi-component systems and evaluate the role of rapid prototyping in the iterative design process.

CLO5: Critically assess the fundamentals of CAM and its integration with CAD to automate production processes, utilizing industry-standard CAM software features for optimized manufacturing.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction to Computer Graphics Fundamentals and CAD • Output primitives (points, lines, curves, etc.) • Introduction to basic 2-D transformations (translation, scaling, rotators) • Introduction to windowing and viewports • Introduction to the concept of CAD, fundamental of CAD • Creating and manipulating designs and drawings of various objects • Examples and important features of CAD software	CL, Seminar, ICT, SDL	CLO1, CLO2
II	Modeling, Assembly and CAM	CL,	CLO3,

	• Introduction to solid modeling, rapid prototyping • Creating wireframe models • Surface modeling • Assembly of parts • Introduction to the concept of CAM, Fundamentals of CAM • Examples and important features of CAM software	Seminar, ICT, PBL	CLO4, CLO5

- **(*) Learning Pedagogies/Methods**

Notes:

(11) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(12) Acronyms/abbreviations of the terms can be placed in the above table.

(sss) Classroom Lecture (CL)
(ttt) Seminars (Student-led and Faculty-moderated)
(uuu) Case-Based Learning (CBL)
(vvv) Micro-Projects/Mini Research Tasks
(www) Industrial Visit/Field Visit/Institutional Visit
(xxx) Problem-Based Learning (PBL)
(yyy) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
(zzz) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
(aaaa) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
(bbbb) Simulation and Role-Play (Academic, Professional, or Policy-based Scenarios)
(cccc) ICT-Enabled Learning (LMS-based Tasks, Digital Resources,Virtual Labs/Webinars)
(dddd) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
(eeee) Inquiry-Based Learning
(ffff) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(P) Internal Assessment

a. Internal Formative assessment [15Marks]

(u) Assignment, Self-learning and Terms work
(v) Seminar/Presentation
(w) Quiz
(x) Attendance

b. Internal Summative Assessment [10Marks]

(u) Mid-term tests [20Marks]
(v) End of Term Examination
(w) Laboratory performance
(x) Viva-voce

(Q) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage(Marks) to Learning levels (BT)			Total Marks
			Remember	Understanding	Application/	

[M.Sc. Defence Science] Semester-I

			(R)	(U)	Analyse& above (A)	
I	**CLO1, CLO2, CLO3**	30	1	4	8	13
II	**CLO4, CLO5**	30	1	3	8	12
		60	**02**	**07**	**16**	**25**

- **Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity	50%
2	End-Semester Examination	Written Exam	50%

(R) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	3	2	1	2	1	2	1	-	-
CLO2	3	2	2	3	3	2	3	2	1	-
CLO3	3	3	3	3	3	2	3	1	1	-
CLO4	2	2	3	3	3	2	3	2	2	1
CLO5	3	3	2	3	3	2	3	2	2	1

Values to **CLO-PLO** matrix are assigned **by judging the importance of the particular CLO** in relation to the **PLOs**.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- **Suggested Learning Materials Books:**

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Computer Graphics	Donald Hearn and M. Pauline Baker	1992	Prentice Hall, Inc.
2	CAD/CAM - Theory and Practice	Ibrahim Zeid	International Edition / 1998	McGraw Hill
3	CAD/CAM – Computer Aided Design and Manufacturing	Mikell P. Groover and Emory W. Zimmers Jr.	-	Prentice Hall International
4	Mastering CAD/CAM	Ibrahim Zeid	Tata McGraw-Hill Edition	Tata McGraw-Hill
5	CAD/CAM	P. N. Rao	-	Prentice-Hall India

- **Online Resources (Open Source)**

Sr.	Description of Resource(s)	Weblink

[M.Sc. Defence Science] Semester-I

No.		
1	NPTEL Course: Computer Aided Design and Manufacturing	https://nptel.ac.in/courses/112102101
2	NPTEL Course: Computer Graphics (IIT Guwahati)	https://nptel.ac.in/courses/106103224
3	Introduction to Computer Graphics	https://nptel.ac.in/courses/106102065
4	Online Course: Physical Modelling using Rapid Prototyping	https://onlinecourses.nptel.ac.in/noc25_ee138/preview