FOUR YEAR UNDER GRADUATE PROGRAM(2024-25)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASC-08**	
2	Course Title	**Advanced Abstract Algebra**	
3	Course Type	**Discipline Specific Course (DSC)**	
4	Pre-requisite(if any)	Knowledge of Abstract Algebra	
5	Course Learning Outcome (CLO)	**At the end of the course, the students will be able to :** ➢ Demonstrate capacity for mathematical reasoning through analyzing, Proving and explaining concepts from advanced algebra. ➢ Understand the concept of Normal and subnormal series, solvable group, state and prove Jordan-Holder theorem. ➢ Understand the concepts of fields, extension of fields and splitting fields of polynomials ➢ . Create, select and apply appropriate algebraic structures such as Galois extensions, Automorphisms of groups and fixed fields, Fundamental theorem of Galois theory to understand and use the Fundamental theorem of Algebra, solvability of polynomials. ➢ Understand the concepts of modules, Noetherian and artinian modules. Prove Wedderburns theorem on finite division rings.	
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		
Unit	Topics	No. of Hours
I	**Counting Principle and Sylow's Theorem** Group-Automorphism, inner automorphism, Automorphism groups and their computations. Conjugacy relation; Normalizer; Counting principle and the class equation of a finite group. Center for Group of prime order. Abelianizing of a group and its universal property ;Sylow's theorems. Sylow's subgroup; Structure theorem for finite Abelian groups.	15
II	**Field Theory** Extension fields; algebraic and transcendental extensions; Separable and inseparable extensions; Perfect fields; Finite fields; Algebraically closed fields.	15
III	**Group Series and Galois Theory** Normal and subnormal series; composition series; Jordan-Holder theorem. Automorphism of extensions; Galois extensions; Fundamental theorem of Galois Theory	15

Dr. S. Dashpute

(Dr. P. K. Sahu)

IV	**Modules** Modules. Submodules Quotient Modules. Homomorphism Isomorphism theorems.Cyclic modules; simple modules; Semi-simple modules; Schuler's lemma; free modules; Noetherian and Artinian modules and rings; Hilbert basis theorem; WedderburnArtin theorem; Uniform modules; primary modules; Noether-Laskar theorem.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended:

1. P.B. Bhattacharya, S. K. Jain, S.R. Nagpaul : Basic Abstract Algebra, Cambridge University press
2. I.N. Herstein : Topics in Albegra, Wiley Eastern Ltd.
3. VivekSahai and VikasBist, Algebra, Narosa Publishing House, 1999.

References Books Recommended:

1. M.Artin, Algeabra, Prentice -Hall of India, 1991.
2. P.M. Cohn, Algebra,Vols. I,II&III, John Wiley & Sons, 1982,1989,1991.
3. N.Jacobson, Basic Algebra, Vols. I , W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. S.Lang, Algebra, 3rd edition, Addison-Wesley, 1993.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I-Groups, Vol.II-Rings, Narosa Publishing House (Vol.I-1996,Vol. II-1999)
6. D.S.Malik, J.N.Mordeson, and M.K.Sen, Fundamentals of Abstract Algebra, McGraw-Hill, International Edition,1997.
7. QuaziZameeruddin and SurjeetSingh : Modern Algebra
8. I. Stewart, Galois theory, 2nd edition, chapman and Hall, 1989.
9. J.P. Escofier, Galois theory, GTM Vol.204, Springer, 2001..
10. Fraleigh , A first course in Algebra Algebra, Narosa,1982.
11. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi,2000.
12. S.K.jain,A. Gunawardena and P.B Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag),2001.
13. S.Kumaresan, Linear Algebra, A Geometric Approach, Prentice-Hall of India, 2000.
14. T.Y. Lam, lectures on Modules and Rings, GTM Vol. 189, SpringerVerlag,1999.

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

Part D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

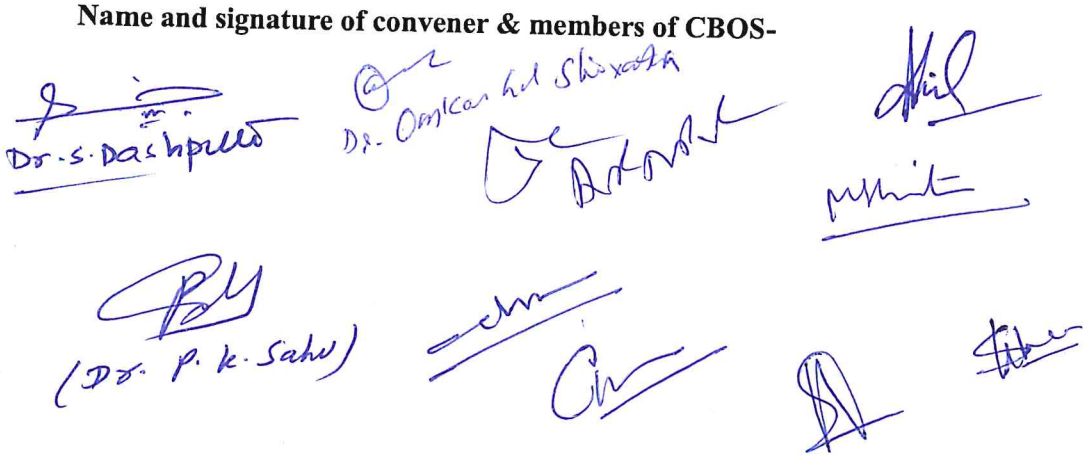
Maximum Marks:	**100 Marks**
Continuous Internal Assessment (CIA):	**30 Marks**
End Semester Examination (ESE):	**70 Marks**

Dr. S. Das Gupta

(Dr. P. K. Sahu)

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 YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE-09**	
2	Course Title	**Measure Theory**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Knowledge of real analysis	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand development of measure and integration theory and Borel, Lebesgue measurability, and compare integration theory of Lebesgue and Riemann with examples and counter examples. ➢ Understand the concept and properties of functions of bounded variation. .	
6	Credit Value	**4C**	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	**Measurable Sets:** Lebesgue outer measure, Lebesgue measure, Properties of measurable sets, Borel sets and their measurability characterization of measurable sets, Non measurable set.	15
II	**Measurable Function:** Definition and properties, Simple, Step and characteristics function, Continuous function, sets of measure Zero. Sequence of functions, Egoroff's theorem structure of measurable function, Lusin theorem, Frechet theorem, Convergence in measure, Riesz theorem.	15
III	**Lebesgue Integral:** Lebesgue integral of a bounded function, Comparison of Riemann integral and Lebesgue integral, Bounded Convergence Theorem, Integral of non negative measurable functions, Fatou's lemma, Monotone convergence theorem, General Lebesgue integral, Lebesgue dominated convergence theorem.	**15**
IV	**Differentiation and Integration:** Dini derivatives, Differentiation of monotone functions, Lebesgue theorem, Function of bounded variation, Differentiation of an integral, Lebesgue sets, Absolutely Continuous Functions, Integral of the derivatives	**15**

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Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. G.de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
2. P.K. Jain and V.P. Gupta, Lebesgue Measure and , New Age International (P) Limited Published, New Delhi, 1986 Reprint 2000).
3. Inder K. Rana, An Introduction to Measure and Integration, Norosa Publishing House, Delhi, 1997

Reference Books Recommended :

1. Richard L. Wheeden and AntoniZygmund, Measure and Integral: An Introduction to Real Analysis, Marcel Dekker Inc.1977.
2. J.H. Williamson, Lebesgue Integration, Holt Rinehart and Winston, Inc. New York. 1962
5. P.R. Halmos, Measure Theory, Van Nostrand, Princeton, 1950.
6. T.G. Hawkins, Lebesgue's Theory, of Integration: Its Origins and Development, Chelsea, New York, 1979.
7. K.R. Parthasarathy, Introduction to Probability and Measure, Macmillan Company of India Ltd., Delhi, 1977.
8. R.G. Bartle, The Elements of Integration, John Wiley & Sons, Inc. New York, 1966.

E-Recourses:

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. S. Dashpalli
Dr. Omkar Lal Shivastava
Dr. P. K. Sahu

FOUR YEAR UNDER GRADUATE PROGRAM (2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE – 10**	
2	Course Title	**General and Algebraic Topology**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Knowledge of Topological spaces and related concepts	
5	Course Learning Outcome (CLO)	**At the end of the course, the students will be able to :** ➢ Understand the concept of products in different topological spaces. ➢ Understand embedding, metrization and its related theorems. ➢ Understand the concept of net, filter and its various topological properties and their inter-relations. ➢ Understand fundamental group and covering spaces.	
6	Credit Value	**4C**	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	**Product Topology** Tychonoff product topology; Separation axioms and product spaces; Compactness and product spaces; Connectedness and product spaces; Countability and product spaces.	15
II	**Embedding and metrization** Embedding lemma and Tychonoff embedding. The Urysohnmetrization theorem. Metrization theorems and Paracompactness-Local finiteness. The Nagata-Smirnov metrization theorem. Para compactness. The Smirnov metrization theorem.	15
III	**Nets and filter** Topology and convergence of nets.Hausdorffness andnets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-filters and Compactness.	15
IV	**The fundamental group and Covering spaces** Homotopy of paths; The fundamental group; Covering Spaces; The fundamental group of the circle and the fundamental theorem of algebra.	15

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Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. Introduction to General Topology ByK.D.Joshi, Wiley Eastern Ltd., 1983.
2. Topology, A First Course By James R. Munkres, Prentice Hall of India Pvt. Ltd., New Delhi,2000.

References Books Recommended:

1. J. Dugundji, Topology, Allyn and Bacon, 1966 (reprinted in India by Prentice Hallof India Pvt. Ltd.).
2. George F.Simmons, Introduction to Topology and modern Analysis, McGraw-Hill Book Company, 1963.
3. J.Hocking and G Young, Topology, Addison-Wiley Reading, 1961.
4. J.L. Kelley, General Topology, Van Nostrand, Reinhold Co., New York,1995.
5. L. Steen and J. Seebach, Counter examples in Topology, Holt, Rinehart and Winston, New York, 1970.
6. W.Thron, Topologically Structures, Holt, Rinehart and Winston, New York,1966.
7. N. Bourbaki, General Topology Part I (Transl.),Addison Wesley, Reading, 1966.
8. R. Engelking, General Topology, Polish Scientific Publishers, Warszawa, 1977.
9. W. J. Pervin, Foundations of General Topology, Academic Press Inc. New York,1964.
10. E.H.Spanier, Algebraic Topology, McGraw-Hill, New York,1966.
11. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
12. Crump W.Baker, Introduction to Topology, Wm C. Brown Publisher, 1991.
13. Sze-Tsen Hu, Elements of General Topology, Holden-Day,Inc.1965.

E-Recourses:

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. S. Dashpute

Dr. Omkar Lokshivastav

Dr. P. K. Sahu

FOUR YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE-11**	
2	Course Title	**Complex Analysis - II**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Basic discussion of complex numbers, complex variable functions and analytic functions.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Understand the fundamental Complex integration. ➢ Understand the concept of residues and apply Cauchy's residue theorem to evaluate integrals. Understand the concept of conformal mappings, bilinear transformations, their properties and classifications. Understand the concept about the spaces of analytic functions. ➢ Understand the concept of Weierstrass' factorization theorem, Riemann Zeta function, Gamma function and its properties. Understand the concept of Analytic Continuation and its properties. Gain knowledge of power series of analytic function. Understand the concept and properties of Harmonic functions on a disc. ➢ Understand the concept of Canonical products, entire function and exponent of Convergence. ➢ Understand the advanced concepts of Analytic functions and its properties.	
6	Credit Value	**4C**	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	**Complex integration:** Complex integration, Cauchy-Goursat. Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem. Laurent's series. Isolated singularities. Meromorphic functions. Maximum modulus principle. Schwarz lemma. The argument principle. Rouche'stheorem Inverse function theorem.	15
II	**Calculus of Residues:** Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to arg z, logz and z^a. Bilinear transformations, their properties and classifications. Definitions and	15

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	examples of Conformal mappings. Spaces of analytic functions. Hurwitz's theorem. Montel's theorem Riemann mapping theorem.	
III	**Entire Functions and Analytic Continuation:** Weierstrass' factorisation theorem. Gamma function and its properties. Riemann Zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem. Analytic Continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation Schwarz Reflection Principle. Monodromy theorem and its consequences.	15
IV	**Harmonic Functionand Canonical products:** Harmonic functions on a disk. Harnack's inequality and theorem. Dirichlet Problem. Green's function, Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. Complex Analysis By L.V.Ahlfors, McGraw - Hill, 1979.
2. J.B. Conway, Functions of one Complex variable, Springer-Verlag, International student-Edition, Narosa Publishing House, 1980.
3. H.K. Pathak, Complex Analysis and Applications, ShikshaSahityaPrakashan , 2019

References Books Recommended:

1. H.A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford 1990.
2. Complex Function Theory By D.Sarason
3. Liang-shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones and Bartlett Publishers International, London, 1996.
4. S. Lang, Complex Analysis, Addison Wesley, 1977.
5. D. Sarason, Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
6. Mark J.Ablowitz and A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University press, South Asian Edition, 1998.
7. E. Hille, Analytic Function Theory (2 Vols.) Gonn& Co., 1959.
8. W.H.J. Fuchs, Topics in the Theory of Functions of one Complex Variable, D.VanNostrand Co., 1967.
9. C.Caratheodory, Theory of Functions (2 Vols.) Chelsea Publishing Company, 1964.
10. M.Heins, Complex Function Theory, Academic Press, 1968.
11. Walter Rudin, Real and Complex Analysis, McGraw-Hill Book Co., 1966.
12. S.Saks and A.Zygmund, Analytic Functions, MonograficMatematyczne, 1952.
13. E.C Titchmarsh, The Theory of Functions, Oxford University Press, London.
14. W.A. Veech, A Second Course in Complex Analysis, W.A. Benjamin, 1967.
15. S.Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, 1997.

E-Recourses:

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

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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 YEAR UNDER GRADUATE PROGRAM(2024-28)

DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM

Part A: Introduction			
Program: Bachelor in Science (Honors/Honors with Research)		**Semester - VIII**	**Session:2024-2025**
1	Course Code	**MASE-12**	
2	Course Title	**Graph Theory**	
3	Course Type	**Discipline Specific Elective (DSE)**	
4	Pre-requisite(if any)	Basic discussion of Graph , Trees and matrices.	
5	Course Learning Outcome (CLO)	**This Course will enable the students to:** ➢ Appreciate the definition and basics of graphs along with types and their examples. ➢ Understand the definition of a tree and learn its applications to fundamental circuits. ➢ Know the applications of graph theory to network flows. ➢ Understand the notion of planarity of a graph. ➢ Relate the graph theory to the real-world problems.	
6	Credit Value	4C	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	**Paths, Circuits and Graph Isomorphisms :** Definition and examples of a graph, Subgraph, Walks, Paths and circuits; Connected graphs, disconnected graphs and components of a graph; Euler and Hamiltonian graphs, Graph isomorphisms, Adjacency matrix and incidence matrix of a graph, Directed graphs and their elementary properties.	15
II	**Planar Graphs :** Planar graph, Euler theorem for a planar graph, Various representations of a planar graph, Dual of a planar graph, Detection of planarity, Kuratowski's theorem. Weighted graph, Travelling salesman problem, shorted path Dijkstra's algorithm.	15

(Dr. P. K. Sahu)

10/6/24

Dr. Ankan Kr Shivastava

III	**Cut-Sets and Cut-Vertices :** Cut-set of a graph and its properties, Fundamental circuits and cut-sets, Cut-vertices, Connectivity and separability, Network flows, 1-isomorphism and 2- isomorphism.	15
IV	**Trees and Fundamental Circuits :** Definition and properties of trees, Rooted and binary trees, Cayley's theorem on a counting tree, Spanning tree, Fundamental circuits, Minimal spanning trees in a connected graph.	15

Part C - Learning Resource

Text Books, Reference Books, Other Resources

Text Books Recommended :

1. R. Balakrishnan & K. Ranganathan (2012). A Textbook of Graph Theory. Springer.
2. Narsingh Deo (2016). Graph Theory with Applications to Engineering and Computer Science. Dover Publications.

References Books Recommended :

3. Reinhard Diestel (2017). Graph Theory (5th edition). Springer.
4. Edgar G. Goodaire & Michael M. Parmenter (2018). Discrete Mathematics with Graph Theory (3rd edition). Pearson.
5. Douglas West (2017). Introduction to Graph Theory (2nd edition). Pearson.:

E-Recourses:

https://onlinecourses.nptel.ac.in
https://epqp.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. S. Dashpute

10/6/2024
Dr. Omkar M Shivantara

Dr. R. V. Bakal

(Dr. P. K. Sahu)

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

PART – A: INTRODUCTION

Program: Bachelor in Science *(Honors/ Honors with Research)*		**Semester: VIII**	**Session: 2024-25**
1	Course Code	**PHSC-08**	
2	Course Title	**Quantum Mechanics**	
3	Course Type	**Discipline Specific Course**	
4	Pre-requisite (if any)	**As per Program**	
5	Course Learning Outcomes (CLO)	At the end of this course, the students will be able to: ➢ Explore uncertainty relations and states with minimum uncertainty. Learn and apply commutation relationships ➢ Master matrix representation of operators and solve the harmonic oscillator. Comprehend angular momentum in quantum mechanics. ➢ Explore spin angular momentum and Pauli's matrices. Master the concept of Clebsch- Gordon coefficients. ➢ Analyze central force problems and spherically symmetric potentials in 3D. Explore parity, square-well potentials, and hydrogen atom solutions	
6	Credit Value	**04 Credits**	**1 Credit = 15 Hours- Learning & Observation**
7	Total Marks	**Maximum Marks: 100**	**Minimum Pass Marks: 40**

PART – B: CONTENT OF THE COURSE

Total No. of Teaching-learning Periods (01 Hr. per period) – 60 Period (60 Hours)

Unit	Topics	No. of Period
I	Super position principle, State with minimum uncertainty product, commutation relationship, completeness and normalization of eigen functions, Dirac-delta function,Bra& Ket notation, matrix representation of an operator, harmonic oscillator and its solutionby matrix method, Heisenberg equation of motion.	15
II	Angular momentum in quantum mechanics, matrix representation of angular momentum, commutation relationships of orbital angular momentum, eigen values and eigen functions of L^2 and L_z, Spin angular momentum: basic introduction, Total angular momentum and its commutation relationship, Pauli`s spin matrices, addition of angular momentum, Clebsch-Gordon coefficients. Applied problem based on momentum and positions.	15
III	Central force problem, spherically symmetric potentials in three dimensions, separation of wave equation, parity, three-dimensional square-well potential and energy levels, the hydrogen atom; solution of the radial equation, energy levels and stationery state wave functions, discussion of bound states, degeneracy.	15
IV	Time- independent perturbation theory, non-degenerate case, first order and second perturbations with the example of an oscillator, degenerate cases, removal of degeneracy in second order, Zeeman effect without electron spin, first-order Stark effect in hydrogen, perturbed energy levels, correct eigen function, occurrence of permanent electric dipole moments.	15

Keywords:	Uncertainty principle, normalization of wavefunction, angular momentum spherically symmetric potential, Time independent perturbation theory, Zeeman effect

Signature of Convener & Members (CBoS) :

10/6/24

PART – C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended -

1. Principles of Quantum Mechanics by R. Shankar
2. Modern Quantum Mechanics" by J. J. Sakurai and Jim Napolitano
3. Introduction to Quantum Mechanics" by David J. Griffiths and Darrell F. Schroeter
4. Quantum Mechanics: A Modern Development" by Leslie E. Ballentine
5. Quantum Mechanics by Leonard I. Schiff

Reference Books Recommended -

1. L. I. Schiff : Quantum mechanics (McGraw-Hill).
2. S. Gasiorowicz, Quantum Physics (Wiley).
3. Landau and Lifshitz : Non-relativistic quantum mechanics.
4. B. Crasemanand Z. D. Powell: Quantum mechanics (Addison Wesley)
5. A. P. Messiah : Quantum Mechanics.
6. J. J. Sakurai : Modern Quantum Mechanics.
7. Mathews and Venkatesa: Quantum Mechanics.
8. G. Aruldhas: Quantum Mechanics (II Edition)

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

1. All e-books of physics https://www.e-booksdirectory.com/listing.php?category=2
2. Free physics textbook in PDF https://www.motionmountain.net/?gclid=CjwKCAjwmq3kBRB_EiwAjkNDp5v8Yy6xK1s0Kma0VR0AWGlichRwFfCC0-vpZK1jrPoEOAnBq8fcqRoCILsQAvD_BwE
3. Cambridge University Books for Physics https://www.cambridgeindia.org/
4. Books for solving physics problems https://bookboon.com/en/physics-ebooks
5. NPTEL Online courses: https://onlinecourses.nptel.ac.in/noc21_ph05/preview
6. Quantum Mechanics https://archive.nptel.ac.in/courses/115/101/115101107/
7. Quantum Mechanics https://nptel.ac.in/courses/115106066

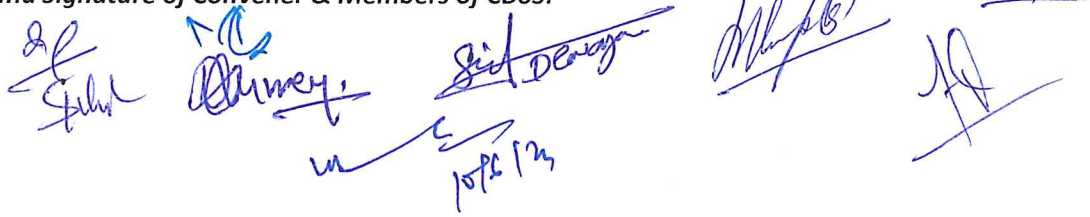
PART – D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

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

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

Name and Signature of Convener & Members of CBoS:



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

PART-A: INTRODUCTION				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**PHSE- 09 T**		
2	**Course Title**	**Solid State Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	By course end, students will master: ➢ Energy band concept in solids, including energy gap analysis. ➢ Bloch function, Kronig-Penny model application for electron description. ➢ Hall effect in semiconductors, Fermi-Dirac distribution temperature impact, and free electron gas behavior in 3D. ➢ Zone schemes exploration, Fermi surface construction, and understanding of nearly free electrons, holes, and open orbits.		
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	**Electrical Properties of solid** Free electron model; Solution of one-dimensional Schrodinger equation in a constant potential; density of states; Fermi energy; Energy bands and origin of energy gap and its magnitude, Bloch function, Kronig-Penny model, Wave equation of electron in periodic potential, crystal moment of an electron, Hall effect **Magnetic properties of solids** Dia, para and ferromagnetism; Langevin's theory of dia and paramagnetism, Curie-Weiss law	11
II	Effect of temperature on F-D distribution, free electron gas in three dimensions. Different zone schemes, reduced and periodic zones, construction of Fermi surfaces, nearly free electrons, electron, hole, open orbits, Calculation of energy bands, Tight binding, Wigner-Seitz, cohesive energy, pseudo potential methods. Experimental methods in Fermi surface studies, quantization of orbits in a magnetic field, de Haas van Alphen Effect, External orbits, Fermi surface of copper	11
III	Lattice dynamics in monoatomic and diatomic lattice: two atoms per primitive basis, optical and acoustic modes, quantization of elastic waves, phonon momentum, inelastic neutron scattering by phonons, Anharmonic crystal interactions-thermal expansion, thermal conductivity, thermal resistivity of phonon gas, umklapp processes, imperfections	11
IV	**Superconductivity** Experimental survey: occurrence of superconductivity, Destruction of superconductivity by magnetic field, Meissner effect, heat capacity, energy gap, MW, and IR properties, isotope effect. Theoretical survey: thermodynamics of superconducting transition, London equation, Coherence length, Cooper pairing due to phonons, BCS theory of superconductivity, BCS ground state, flux quantization of superconducting ring, duration of persistent currents, Type II superconductors, Vortex states, estimation of Hc1 and Hc2, single particle and Josephson superconductor tunneling, DC/AC Josephson effect, Macroscopic quantum interference. High-temperature superconductors, critical fields and currents	12
Keywords	*Free electron model, Kronig Penny Model, Hall effect, Zone schemes, fermi surfaces, optical and acoustic modes, Superconductivity, BCS theory*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Solid State Physics by Neil W. Ashcroft and N. David Mermin
2. Introduction to Solid State Physic by Charles Kittel
3. Solid State Physics by J. S. Blakemore
4. Quantum Theory of Solids by Charles Kittel
5. Introduction to Superconductivity by Michael Tinkham

Reference Books Recommended–

1. Principles of the Theory of Solids by J. M. Ziman
2. Electronic Properties of Materials by Rolf E. Hummel
3. Solid State Physics: An Introduction by Philip Hofmann
4. Lattice Dynamics by A. A. Maradudin
5. Superconductivity, Second Edition by J. B. Ketterson and S. N. Song
6. Fundamentals of Superconductivity by John Robert Schrieffer
7. The Physics of Solids by Richard Turton
8. Solid State Physics: Structure and Properties of Materials by M. A. Wahab

Online Resources–

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

1. Condensed Matter Physics https://archive.nptel.ac.in/courses/115/106/115106061/
2. Advanced Condensed Matter Physicshttps://archive.nptel.ac.in/courses/115/103/115103102/
3. Introduction to condensed matter physics https://homepages.iitb.ac.in/~kdasgupta/pdf/PH409[Aug2013].pdf
4. Introduction to solid state physics https://archive.nptel.ac.in/courses/115/104/115104109/

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

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

Continuous Internal Assessment(CIA): **(By Course Teacher)**	Internal Test / Quiz-(2): Assignment / Seminar - Total Marks -	**20 +20** **10** **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.,**1 out of 2** from each unit-**4x10=40 Marks**		

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 *(Honors/ Honors with Research)*		**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSC-09 P**	
2	**Course Title**	**Solid State Physics**	
3	**Course Type**	**Discipline Specific Elective**	
4	**Pre-requisite** (if, any)	**As per Program**	
5	**Course Learning. Outcomes(CLO)**	After the completion of the course, the Students are expected to : ➢ Analyse recorded data and formulate it to get desired results. ➢ Interpret results and check for attainment of proposed objectives related to theory of semiconductors. ➢ Apply theory and principle of semiconductors for various device applications ➢ Various electronics experiments and some advanced experiments in Physics	
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***
7	**Total Marks**	**Max. Marks:50**	**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performancePeriods:30 Periods (30 Hours)		
Module	**Topics(Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2. To measure the Magnetic susceptibility of Solids 3. To determine the Coupling Coefficient of a Piezoelectric crystal 4. To measure the Dielectric Constant of a dielectric Materials with frequency 5. To study the PE Hysteresis loop of a Ferroelectric Crystal 6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis 7. Determination of ionization potential of Lithium/Mercury 8. To study I-V characteristics of photovoltaic solar cell and its efficiency 9. Study of optoelectronic devices and verification of inverse square law 10. Determination of 'h' Planck's constant by Photoelectric effect 11. Determination of 'e/m' by Thomson method 12. Determination of Ionization Potential using Thyratron valve 13. Study of absorption coefficient of KMnO4	**30**
Keywords	*Magnetic susceptibility, Dielectric constant, PE hysteresis loop, BH curve, Resistivity, Hall coefficient, Ionization potential, Planck's constant*	

Signature of Convener & Members (CBoS):

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books:

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
3. Practical Physics B.Sc III : R P Goyal, Shivlal Agrawal Publications
4. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd.,
5. London, 1962.
6. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
7. Indu Prakash: Practical Physics
8. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014

Reference Books:

1. Experimental Methods for Engineers by J.P. Holman
2. Semiconductor Physics and Devices by Donald A. Neamen
3. Optoelectronics and Photonics: Principles and Practices by Safa O. Kasap
4. Piezoelectricity: Evolution and Future of a Technology by Walter Heywang, Karl Lubitz, and Wolfram Wersing

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

1. Link for e-Books for Physics: Physics Practical:
   https://www.iiserkol.ac.in/~ph324/experiment_list.html
2. Virtual Lab :https://vlab.amrita.edu/?sub=1&brch=282
3. https://vlab.amrita.edu/index.php?sub=1&brch=282&sim=370&cnt=3
4. https://bop-iitk.vlabs.ac.in/exp/energy-band-gap/simulation.html
5. http://vlabs.iitkgp.ac.in/ssd/index.html#
6. http://vlabs.iitkgp.ac.in/psac/newlabs2020/ssds/#
7. https://ae-iitr.vlabs.ac.in/List%20of%20experiments.html
8. https://da-iitb.vlabs.ac.in/List%20of%20experiments.html
9. Virtual Labs at Amrita Vishwa Vidyapeetham, https://vlab.amrita.edu/?sub=1&brch=74

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**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
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:

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

PART-A: INTRODUCTION				
Program:Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE- 10**		
2	**Course Title**	**Atomic and Molecular Physics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	**As per Program**		
5	**Course Learning. Outcomes (CLO)**	➢ Explain Vector atom model and use it for analyzing hydrogen spectra. ➢ Analyze various spectra and check for possibility of a given transition ➢ Explain and Apply Raman's effect and spectroscopy for various application. ➢ Appreciate the extraordinary characteristic of lasers and differentiate it from an ordinary light. ➢ Explore more about scientific contribution of Sir C V Raman		
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	Vector atom model, quantum numbers associated with vector atom model, Spectra of hydrogen, deuteron and alkali atoms spectral terms, doublet fine structure, screening constants for alkali spectra for s, p, d and f states, selection rules, singlet, triplet fine structure in alkaline earth spectra, L-S and J-J coupling	**15**
II	Different types of Spectra, Discrete set of electronic energies of molecules, quantization of vibrational energies, determination of inter-nuclear distance, Transition rules for vibration and electronic vibration spectra. Pure rotational and rotation vibration spectra, Quantization of States Dissociation limit for the ground and other electronic states, transition rules for pure rotation and electronic- rotation Spectra	**15**
III	Raman effect, Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra, experimental arrangements for Raman spectroscopy. Application of Raman Spectroscopy, Resonance Spectroscopy, X-Rays, Production of X-rays, X-ray spectra, Mosley's law, X-Ray Spectroscopy,	**15**
IV	Atom Radiation interactions: Semi-classical description of radiation. Absorption, spontaneous and stimulated emissions, Einstein's A and B coefficients, Coherent and Incoherent emissions, LASERs and MASERs, Line widths, various types of line broadening, two-level atoms in a radiation field	**15**

Keywords	Vector atom model, hydrogen spectra, electronic transitions, vibrational spectra, rotational spectra, Raman effect

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended –

1. Atomic Physics by J.B. Rajam
2. Molecular Spectroscopy by Ira N. Levine
3. Fundamentals of Molecular Spectroscopy by C.N. Banwell and E.M. McCash
4. Lasers: Theory and Applications by K. Thyagarajan and A.K. Ghatak
5. Spectroscopy by B.P. Straughan and S. Walker
6. Modern Spectroscopy by J. Michael Hollas.

Reference Books Recommended –

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
3. Modern Physics, R.A. Serway, C.J. Moses, and C. A. Moyer, 2005, Cengage Learning
4. Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

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

1. https://archive.nptel.ac.in/courses/115/105/115105100/
2. https://archive.nptel.ac.in/courses/115/101/115101003/#

PART -D: ASSESSMENT AND EVALUATION

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.,**1 out of 2** from each unit-**4x10=40 Marks**	

Name and Signature of Convener & Members of CBoS:

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

PART-A: INTRODUCTION				
Program: Bachelor in Science *(Honors/Honors with Research)*		**Semester - VIII**		Session: 2024-2025
1	**Course Code**	**PHSE-11**		
2	**Course Title**	**Statistical Mechanics**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	At the end of this course, the students will be able to: ➢ Explain the connection between statistics and thermodynamics. Define the phase space of the classical system. ➢ Define three different types of Ensembles and discuss corresponding theories. Define partition functions for different canonical systems. ➢ Explain energy, energy-density fluctuations, and correspondence of various ensembles. Explain statistics of different quantum mechanical ensembles. ➢ Discuss Bose-Einstein (BE) Condensate w.r.t. liquid Helium II, Define and discuss electron gas behavior w.r.t. Fermi Dirac Statistics ➢ Discuss Virial expansion of the equation of state. Discuss Brownian motion and Einstein and Smoluchowski theory		
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	**Foundation of Statistical Mechanics** Macroscopic and microscopic states, contact between statistics and thermodynamics, physical significance of Ω (N,V, E), the classical gas, entropy of mixing and Gibb's paradox, phase space of classical system, Liouville`s theorem and its consequences, quantum states and phase space.	15
II	**Elements of ensemble theory** A system in microcanonical, canonical, and grand canonical ensembles, partition functions, physical significance of statistical quantities, example of classical system, energy and energy-density Fluctuations and mutual correspondence of various ensembles	15
III	**Formulation of quantum statistics** Quantum mechanical ensemble theory, density matrix, statistics of various quantum mechanical ensembles, system composed of indistinguishable particles. Maxwell-Boltzmann, Bose-Einstein, Fermi-Dirac distributions Thermodynamic behavior of an ideal Bose gas, Bose-Einstein condensation and, elementary excitations in liquid helium II, Thermodynamic behavior of an ideal Fermi gas, the electron gas, non-relativistic and relativistic degenerate electron gas, theory of white dwarf stars.	15
IV	**Statistical Mechanics of interacting systems** The method of cluster expansion for a classical gas, Virial expansion of the equation of state. Theory of phase transition – general remark on the problem of condensation, Fluctuations: thermodynamic fluctuations, Spatial correlation in a fluid Brownian motion: Einstein Smoluchowski's theory of Brownian motion	15
Keywords	*Macro and microstates, ensembles, phase space, partition function, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, Fluctuations, Brownian motion*	

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Reference Books Recommended –

1. L. D. Landau & E. M. Lifshitz (Butter worth and Heinemann Press).
2. Federick Reif, Fundamental of statistical and thermal physics (McGraw-Hill publishers)
3. Kerson Huang, Statistical Mechanics (Wiley Eastern)
4. Charles Kittel, Elemental Statistical Physics

Text Books Recommended –

1. Brij Lal, N. Subrahmanyam, P S Hemne; Heat and Thermodynamics and Statistical Physics
2. R. K. Pathria, Statistical Mechanics (Pergamon Press)
3. Statistical and Thermal Physics an introduction; Michael J R Hoch

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

1. Statistical Mechanicshttps://archive.nptel.ac.in/courses/115/106/115106126/
2. Introduction to Statistical Mechanics https://archive.nptel.ac.in/courses/115/103/115103113/
3. Statistical Mechanics https://archive.nptel.ac.in/courses/115/106/115106111/
4. Statistical mechanics http://www.digimat.in/nptel/courses/video/115106126/L01.html

PART -D: ASSESSMENT AND EVALUATION

Suggested Continuous Evaluation Methods:

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

Continuous Internal Assessment (CIA): **(By Course Teacher)**	Internal Test / Quiz-(2):	**20 & 20**	Better marks out of the two Test / Quiz + obtained marks in Assignment shall be considered against **30** Marks
	Assignment / Seminar -	**10**	
	Total Marks -	**30**	
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:

10/6/24

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

PART-A: INTRODUCTION				
Program : Bachelor in Science *(Honors/Honors with Research)*			**Semester -VIII**	**Session: 2024-2025**
1	**Course Code**	**PHSE-12 T**		
2	**Course Title**	**Microprocessor**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	***As per program***		
5	**Course Learning. Outcomes (CLO)**	**After completion of this course a student will be able to-** ➢ *Understand the basics of digital computer, Clarify the concept of memories used in computer system* ➢ *Familiar with buses and registers available in microprocessor* ➢ *Understand the addressing modes, data transfer group, arithmetic group, logical group etc.Know about Assembly Language, High-Level and Area of applications of various languages* ➢ *Able to use Assembly Language for programming of microprocessor*		
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	**Digital Computer:** Generation of computer, Digital Computer, Its basic components: Input and output devices, Central Processing Unit (CPU) and its organization, **Primary memory:** Introduction, Types of Primary memory - RAM, SDRAM, SGRAM, DDR SDRAM, SIMM, DIMM, ROM, PROM, EPROM, EEPROM, **Secondary memory:** Construction and working principles of Hard Disc, Floppy Disc, Optical Disc, Magnetic Bubble Memory. Cache memory, Real and Virtual Memory. Memory hierarchy	11
II	**Microprocessor:** Introduction and evaluation, Architecture and functional organization of Intel 8085, ALU, Timing and Control unit, **Buses:** Address Bus, Data Bus and Control Bus. Bus architecture: PCI, ISA, USB and AGP. **Registers:** ACC, General purpose register, Stack pointer, Program counter, Instruction register, Temporary register. Processing speed of processor, Types of processors (Basic Idea), Opcode and Operand, Pin Diagram and Pin Configuration of 8085, Intel 8085 instructions, Instruction cycle, Timing diagram	12
III	**Instruction set of 8085:** Addressing modes, Data transfer group, Arithmetic group, Logical group, Branch group, Stack, I/O and Machine control group. **Programming of Microprocessor:** Assembly Language, High-Level languages. Advantages and Disadvantages of high-level languages, Area of applications of various languages, Stack, Subroutines, Modular programing, Structured programing	11
IV	**Assembly Language Programs:** Addition of two 8-bit number; sum 8-bit, Addition of Two 8-bit number; sum 16-bit, 8-bit subtraction, Shift an 8-bit/ 16-bit number left by 1-bit, Shift an 8-bit/ 16-bit number left by 2-bit,Find larger number of two numbers, Find the largest number in a data array, Find smaller number of two numbers, Find the smallest number in a data array, To arrange a series of numbers in Descending order, To arrange a data array in ascending order, 8-bit multiplication; product in 16-bit, 8-bit division	11
Keywords	***CPU, Memory, Microprocessor, Buses, Registers, Opcode, Instructions, Addressing mode, Assembly language, Programming.***	

Signature of Convener & Members (CBoS) :

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PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. MicroprocessorArchitectureProgrammingandapplicationswith8085,R.S.Goankar,2002,PrenticeHall
2. Digital electronics and Microcomputers, R K Gaur, Dhanpat Rai Publications
3. Fundamentals of Microprocessors and Microcontrollers, B Ram, Dhanpat Rai Publications

Reference Books Recommended –

1. Introduction to microprocessor – Aditya Mathur, Tata McGraw Hills, New Delhi
2. Microprocessor8085: Architecture, Programming and interfacing, A.Wadhwa,2010,PHILearning
3. Microprocessors and Interfacing Devices, Rupender Singh & Sunita Jain, CBS Publications

Online Resources–

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

1. https://www.freebookcentre.net/Electronics/MicroProcessors-Books.html
2. https://www.phindia.com/Books/ShoweBooks/MTMyNg/Microprocessors-Microcontrollers
3. https://books.google.co.in/books?id=P-n3kelycHQC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false
4. https://www.youtube.com/watch?v=UjagUR2i_Ok
5. https://www.youtube.com/watch?v=dLGw66gKKkQ
6. https://www.classcentral.com/course/swayam-microprocessors-and-microcontrollers-9894
7. https://www.youtube.com/watch?v=hwwhsNOqqm8
8. https://www.youtube.com/watch?v=wUmi3roAqmk

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): Assignment / Seminar - Total Marks -	**20 +20** **10** **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 UNDER GRADUATE PROGRAM (2024 – 28)
DEPARTMENT OF PHYSICS
COURSE CURRICULUM

PART-A: INTRODUCTION				
Program : Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: 2024-2025
1	**Course Code**	**PHSE-12 P**		
2	**Course Title**	**Microprocessors**		
3	**Course Type**	**Discipline Specific Elective**		
4	**Pre-requisite** (if, any)	**As per Program**		
5	**Course Learning. Outcomes(CLO)**	**After completion of this course a student will be able to-** ➢ *Understand the working of logic gates and realization of Functions* ➢ *Clarify the concept of combinational logic circuits* ➢ *Understand the differences between MUX, DMUX, Encoder and Decoder and their use* ➢ *Familiar with basic memory elements (Flip-flop)*		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks:50**		**Min Passing Marks:20**

PART -B: CONTENT OF THE COURSE		
Total No. of learning-Training/performance Periods:30 Periods (30 Hours)		
Module	**Topics (Course Contents)** **At least 10 of the following or related Experiments**	**No. of Period**
Lab./ Experiment Contents of Course	1. Write the program using 8085 Microprocessor for Addition and Subtraction of numbers using direct addressing mode 2. Write the program using 8085 Microprocessor for Addition and Subtraction of numbers using indirect addressing mode 3. Write the program using 8085 Microprocessor for Multiplication by repeated addition 4. Write the program using 8085 Microprocessor for Division by repeated subtraction 5. Write the program using 8085 Microprocessor for Handling of 16-bit Numbers 6. Write the program using 8085 Microprocessor to Use of CALL and RETURN Instruction 7. Write the program using 8085 Microprocessor to add two hexa decimal & decimal numbers 8. Write the program using8085Microprocessor to subtract two hexadecimal & decimal numbers 9. Write the program using 8085 Microprocessor for Addition of two 8-bit numbers 10. Writetheprogramusing8085Microprocessor for Addition of two 16-bit numbers 11. Write a program to perform multiplication of two 8-bit numbers using bit addition method 12. Write a program to perform multiplication of two 8-bit numbers using bit rotation method 13. Write a program to perform division of two 8-bit numbers using Repeated Subtraction method 14. Write a program for Finding the largest and smallest number from an array 15. Write a program for Find 1's & 2's complement of a 8 bit number 16. Write a program to Transfer Block of data bytes from one memory location to another 17. Any Similar programming	**30**
Keywords	***Microprocessor, Addressing mode, CALL, RETURN, Programming***	

Signature of Convener & Members (CBoS):

10/6/24

PART–C: LEARNING RESOURCES

Text Books, Reference Books and Others

Text Books Recommended–

1. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh S. Gaonkar
2. Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096 by Krishna Kant
3. Fundamentals of Microprocessors and Microcontrollers by B. Ram
4. 8085 Microprocessor and its Applications by A. Nagoor Kani
5. The 8085 Microprocessor: Architecture, Programming and Interfacing by K. Udaya Kumar and B.S. Umashankar

Reference Books Recommended–

1. Digital Electronics: Theory and Practical- Virendra Kumar, New Age International Publications
2. Digital Electronics – A Comprehensive Lab Manual- Cherry Bhargava, B S Publication
3. Digital electronics experiment manual- Toger Tokheim, McGraw Hill
4. Handbook of Experiments in Electronics and Communication- B Sasikala & S P Rao, Vikas Publishing
5. Practical Digital Electronics Manual- Nigel P Cook, Prentice Hall

Online Resources–

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

1. https://www.ssit.edu.in/dept/assignment/8085labmanual.pdf
2. https://gnindia.dronacharya.info/ECE/Downloads/Labmanuals/Microprocessor_Lab_Manual.pdf
3. https://people.iitism.ac.in/~download/lab%20manuals/ece/5.%20ECC211%20Microprocessor%20&%20Microcontroller%20Lab.pdf
4. https://www.technicalsymposium.com/microprocessor_lab.pdf
5. https://mjcollege.ac.in/images/labmannuals/MICROPROCESSORLABMANUALBIT281.pdf

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**	Better marks out of the two Test / Quiz +obtained marks in Assignment shall be considered against **15** Marks
	Assignment/Seminar +Attendance-	**05**	
	Total Marks -	**15**	
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:

10/6/24

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

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSC-08T**		
2	**Course Title**	**ORGANIC & INORGANIC CHEMISTRY-II**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Master mechanisms, kinetics, mechanism and reactivity factors in organic chemistry.*** ➢ ***Understand and predict regioselectivity in aromatic electrophilic substitution reactions.*** ➢ ***Utilize symmetry and group theory to analyze molecules and predict spectroscopic features.*** ➢ ***Understand and classify supramolecular chemistry***		
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	**MECHANISTIC ORGANIC CHEMISTRY** Unit I: A) Reaction mechanism: Types of reaction, Types of mechanism, kinetic and thermodynamic control, Hammond's postulate, Curtin-Hammett principle, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, trapping of intermediates, checking for common intermediate, competition and cross-over experiments, isotope effects, Hard and soft acids and bases. B) Reaction Kinetics: Reaction co-ordinate diagrams, rate laws and methods of determining concentration. C) Effect of Structure on reactivity: Resonance and field effects, Steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft Equation. D) Aromatic electrophilic substitution: The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The o/p ratio, ipso attack, orientation in benzene ring with more than one substituent, orientation in another ring system. Friedel-Crafts reaction, Vilsmeir-Hack reaction, Gatterman-Koch reaction, Pechman reaction, Diazonium coupling, Blanc chloromethylation, Kolbe– Schmitt reaction	12
II	**SUBSTITUTION REACTIONS** A) Aliphatic nucleophilic substitution: The SN1, SN2, mixed SN1, SN2 and SET and SNi mechanisms. Nucleophilicity, effect of leaving group, ambient nucleophiles and ambient substrates regiospecificity, substitution at allylic and vinylic carbon atoms, Mitsunobu reaction B) Concept of neighbouring group participation: Anchimeric assistance with mechanism, neighboring group participation by π and σ bonds, classical and non-classical carbocations, Intramolecular displacement by hydrogen, oxygen, nitrogen, sulphur and halogen. Alkyl, cycloalkyl, aryl participation, participation in bicyclic system, migratory aptitude. C) Aromatic Nucleophilic Substitution: A general introduction to different mechanisms of aromatic nucleophilic substitution SNAr, SN1, benzyne and SRN1 mechanisms,	11

	arynes as reaction intermediate, Reactivity - effect of substrate structure leaving group and attacking nucleophile. The Von Richter and Smiles rearrangements, Chichibabin amination reaction. Benzyne: Structure, methods of generations and reactions	
III	**Symmetry and Group Theory in Chemistry** Symmetry elements and symmetry operation, definition of group, subgroup, relation between order of a finite group and its subgroup. Conjugacy relation and classes. point symmetry group. Schonflies symbols, representations of groups by matrices (representation for the C_n, C_{nv}, C_{nh}, D_{nh} etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their uses in spectroscopy.	**11**
IV	**Supramolecular Chemistry:** Concepts and language, Molecular recognition Molecular receptors for different types of molecules including arisonic substrates, design and synthesis of coreceptor molecules and multiple recognition. Supramolecular reactivity and catalysis. **Transport processes and carrier design.** Supramolecular devices. Supramolecular photochemistry, Supramolecular electronic, ionic and switching devices. Some examples of self-assembly in supramolecular chemistry. **Metal Clusters:** Higher boranes, carboranes, metalloboranes and metallocarboranes, compounds with metal-metal multiple bonds. **Isopoly and Heteropoly Acids and Salts.**	**11**
Keywords	***Reaction mechanisms, kinetics, regioselectivity, electrophilic substitution, substitution mechanisms, neighboring group participation, symmetry, group theory, supramolecular chemistry***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended -

Textbooks Recommended

1. *Soni, P. L., Bahl, B. S., & Bahl, A. (2019). Organic Chemistry.S. Chand & Company Ltd.*
2. *Morrison, R. T. & Boyd, R. N. (2012). Organic Chemistry. Pearson Education.*
3. *Kumar, A. (2004). Elements of Group Theory for Chemists. New Delhi, India: Affiliated East-West Press.*
4. *Mukherji, S. M. & Chakrabarti, S. P. (2007). Reaction Mechanisms in Organic Chemistry. Macmillan India Ltd.*

Reference Books Recommended

1. *Carey, F. A. & Sundberg, R. J. (2007). Advanced Organic Chemistry. Springer.*
2. *Ahluwalia, V. K. & Aggarwal, R. (2010). A Textbook of Organic Chemistry. Narosa Publishing House.*
3. *Carruthers, W. (1987). Modern Organic Synthesis. Springer.*
4. *Smith, M. B. & March, J. (2006). March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. John Wiley & Sons.*
5. *Grossman, R. B. (2004). The Art of Writing Reasonable Organic Reaction Mechanisms. Oxford University*

Online Resources–

- https://onlinecourses.nptel.ac.in/noc20_cy30/preview
- https://swayam.gov.in/
- https://www.coursera.org/
- https://www.edx.org/
- https://onlinecourses.nptel.ac.in/noc20_cy30/preview

PART -D: Assessment and Evaluation

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

Name and Signature of Convener & Members of CBoS:

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

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSC-08P**		
2	**Course Title**	**CHEMISTRY LAB. COURSE-VIII**		
3	**Course Type**	**DSC**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To understand the basic principles involved in separation of organic binary mixture and identify the components by qualitative analysis.* ➢ *To get trained in one step/two-step synthesis of commercially important organic compounds based on different chemical processes.* ➢ *To learn about separation and purification of organic mixtures by chromatography* ➢ *To identify and characterize prepared and separated compounds by IR spectral analysis.*		
6	**Credit Value**	**1 Credits**	*Credit =30 Hours Laboratory or Field learning/Training*	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	**Organic Synthesis** (i) Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography. (ii) Synthesis of β-Naphthyl acetate / Hydroquinone diacetate. (iii) Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol (iv) Grignard reaction: Synthesis of triphenylmethanol from benzoic acid (v) Aldol condensation: Dibenzalacetone from benzyldehyde (vi) Sandmeyer reaction: p-chlorotoluene from p-toluidine / o-chlorobenzoic acid from anthranilic acid. (vii) Acetoacetic ester Condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. (viii) Cannizzaro reaction: 4- chlorobenzaldehyde as substrate / Benzoic acid and benzyl alcohol. (ix) Friedel Crafts Reaction: β-Benzoyl propionic acid from succinic anhydride and benzene. (x) Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and bromoaniline. (xi) Clemmenson reduction: Hydrocarbons from ketones. (xii) Nitration: Picric acid from phenol (xiii) Reduction: Acetic acid from ethanol. (xiv) Esterification: Oil of Wintergreen from salicylic acid. (xv) Sulphonation: Sulphanilic acid from aniline. **Separation, purification and identification of compounds of binary mixtures (solid-solid, liquid-solid) using chemical tests.** Identification of functional group of organic compounds by FTIR Separation, purification and identification of compounds of binary mixtures TLC	**30**

	and column chromatography.	
Keywords	***Organic Synthesis, Separation techniques (column chromatography, TLC), Identification techniques (FTIR), Volumetric analysis, Chromatography (paper, column), Flame photometry, Spectrophotometry (UV-Vis), Conductometry, pH-metry.***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Textbooks Recommended:

1. Basavarajaiah, S. M., Nagesh, G. Y., & Ramakrishna Reddy, K. (2016). *Compendious Practical Organic Chemistry: Preparations, Isolation, and Chromatography*. New Age International.
2. Manna, A. K. (2011). *Practical Organic Chemistry*. Books & Allied (Publishers) Pvt. Ltd.
3. Peesapati, V. (2017). *Practical Organic Chemistry – A Primer*. BSP Books.

Reference Books Recommended:

1. Vogel, A. I. (**1957**). *Practical Organic Chemistry*. Longman Scientific & Technical.
2. Mann, F. G., & Saunders, B. C. (**2004**). *Practical Organic Chemistry* (4th Ed.). Longman.
3. Jeffery, G. H., Mendham, J., Denney, R. C., & Barnes, J. (**2000**). *Vogel's Textbook Of Quantitative Chemical Analysis* (6th Ed.). Longman.
4. Harris, D. C. (**1998**). Quantitative Chemical Analysis (5th Edition). W H Freeman & Co

Online Resources–

- **e-Resources / e-books and e-learning portals**
- **(https://www.wiley.com/en-us/Microscale+Inorganic+Chemistry%3A+A+Comprehensive+Laboratory+Experience-p-9780471619963)**
- **(https://onlinelibrary.wiley.com/doi/book/10.1002/9780470405840)**
- **(https://www.amazon.com/Physical-Chemistry-Molecular-Donald-McQuarrie/dp/0935702997)**
- **(https://www.amazon.com/Laboratory-Manual-Physical-Chemistry-Davison/dp/1297998979)**

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** **V. Performed the Task based on lab. work - 20 Marks** **W. Spotting based on tools & technology (written) – 10 Marks** **X. 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 *(Honors/Honors with Research)*		**Semester - VIII**		Session: **2024-2025**
1	**CourseCode**	**CHSE-08P**		
2	**CourseTitle**	**ELECTROCHEMISTRY AND SURFACE CHEMISTRY LAB. COURSE**		
3	**CourseType**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**CourseLearning.Outcomes(CLO)**	➢ ***To acquire the knowledge of surface tension*** ➢ ***To apply the principle of conductance in studying different applications.*** ➢ ***To apply various concepts of Physical Chemistry and use instruments in studying various applications.*** ➢ ***To acquire the surface tension – concentration relationship for solution***		
6	**CreditValue**	**01Credit (Practical)**	***(Credit = 30Hrs laboratory or Field learning / training)***	
7	**TotalMarks**	**Max.Marks:50**		**MinPassingMarks:20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics(Coursecontents)**	**No.of Period**
Lab./Field Training/ Experiment Contents of Course	**Conductometry** Estimation of aspirin from tablet. Determination of relative strengths of different acids. Determination of the strength of strong and weak acids in a given mixture conductometrically. **Potentiometry/pH metry** Determination of temperature dependence of EMF of a cell. To determine pK_a of the given monobasic acid by pH metric titration. Determination of the dissociation constant of monobasic/dibasic acid by Albert-Serjeant method. **Surface Tension:** Determination of CMC of Surfactants by (1) Surface Tension method (2) Conductometric method To study surface tension – concentration relationship for solution (Gibb's equation). To study the adsorption of oxalic acid on charcoal and to verify Freundlich adsorption isotherm. To determine the parachor of the given liquid. Compare CMC of different surfactants by surface tension method.	**30**
Keywords	Conductometry, potentiometry, pH-metry,CMC	

SignatureofConvener&Members (CBoS):

PART–C
LearningResources:TextBooks,ReferenceBooksandOthers
Textbook Recommended 1. *Athawale, V. D., & Oza, N. R. (2001). Experimental physical chemistry. New Age International Publishers.*
OnlineResources– ➢ **SWAYAM https://swayam.gov.in** ➢ **e-Pathshala https://epathshala.nic.in**

Part-D:AssessmentandEvaluation		
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)**	**Continuous Internal Assessment (CIA):** **(By Course Teacher)**	Better marks out of two Test/Quiz + obtained marks in assessment shallbe consideredagainst 15Marks
End Semester Exam(ESE):	**Laboratory/Field Skill Performance : on spot Assessment** **A: Perform task Based on the lab work- 20 Mark** **B: Spotting Based on tools and techniques- 10 marks** **C: Viva-voce (Based on principle/technology)-05 Marks**	**Managed by Course teacher as per Lab. Status.**

Name and Signature of Convener & Members of CBoS:

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

PART-A: Introduction				
Program:Bachelor in Science *(Honors/Honors with Research)*		**Semester–VIII**		Session:**2024-25**
1	**Course Code**	**CHSE-09T**		
2	**Course Title**	**APPLICATION OF SPECTROSCOPY -II**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning. Outcomes(CLO)**	➢ ***To interpret the vibrational spectra of molecules to identify functional groups and understand their bonding modes.*** ➢ ***To gain proficiency in analyzing NMR and ESR spectra to determine the structure and electronic environment of atoms within a molecule.*** ➢ ***To equip students with the ability to utilize Mössbauer spectroscopy for the characterization of iron-containing materials, analyzing their oxidation state and local environment.*** ➢ ***To develop the skills to interpret mass spectra, including fragmentation patterns, to determine the molecular weight and structure of unknown compounds.***		
6	**Credit Value**	**03Credit**	***Credit = 15 Hours - learning & Observation***	
7	**TotalMarks**	**Max.Marks:100**		**MinPassingMarks:40**

PART-B: Content of the Course

Total No.ofTeaching–learningPeriods (01Hr.perperiod)

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Vibrational Spectroscopy** Instrumentation and sample handling in IR Spectroscopy, Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (Ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and fermi resonance. FTIR. **Optical Rotatory Dispersion (ORD)and Circular Dichroism (CD)** Definition, deduction of absolute configuration, Octant rule for Ketone	12
II	**Nuclear Magnetic Resonance Spectroscopy** General introduction and definition, chemical shift, spin-spin interaction, shielding mechanism of measurement, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry hindered rotation. **Carbon-13 NMR Spectroscopy** General consideration, chemical shift (aliphatic, olefinic alkyne, aromatic,	11

	heteroaromatic and carbonyl carbon), coupling constants. **Two-dimension NMR Spectroscopy:** COSY, NOESY, DEPT, INEPT, APT and INADEQUATE Techniques.	
III	**Electron Spin Resonance Spectroscopy** Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron). **Mossbauer Spectroscopy** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe^{+2} and Fe^{+3} compounds including those of intermediate spin, (2) Sn^{+2} and Sn^{+4} compounds - nature of M - L bond coordination number, structure and(3) Detection of oxidation state and inequivalent MBatoms.	**11**
IV	**Mass Spectrometry** Introduction, ion production - EI, CI, FD and FAB, factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, Mc Lafferty rearrangement.Nitrogenrule.High-resolution mass spectrometry.Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.	**11**
Keywords	***Vibrational Spectroscopy, Infrared Spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Carbon-13 NMR, Two-Dimensional NMR (COSY, NOESY, DEPT, etc.), Electron Spin Resonance (ESR), Mössbauer Spectroscopy, Mass Spectrometry, Functional Group Identification, Organic Structure Determination***	

Signature of Convener & Members (CBoS):

PART–C

LearningResources: Textbooks, Reference Books andOthers

Textbooks Recommended

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House.*
2. *Sharma, Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recoomended

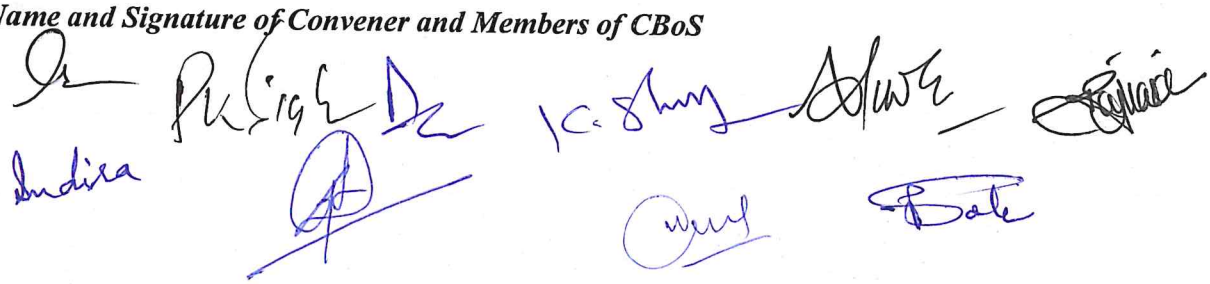
1. *Nakamoto, K. (2009). Infrared and Raman Spectra: Inorg. and coordination compounds. Wiley.*
2. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectroscopy. in Inorg. Chem. Ellis Horwood.*
3. *Martin, M. L., Delpeuch, J. J., & Martin, G. J. (1982). Practical NMR Spectroscopy. Heyden.*
4. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
5. *Abraham, R. J., Fisher, J., & Loftus, P. (2011). Introduction to NMR Spectroscopy. Wiley.*
6. *Dyer, J. R. (1978). Application of Spectroscopy of Organic compounds. Prentice Hall.*
7. *Williams, D. H., & Fleming, I. (1990). Spectroscopic Methods in Org. Chem. Tata McGraw Hill.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://swayam.gov.in/nd1_noc19_ch08/preview
- https://www.coursera.org/learn/spectroscopy-chemistry
- https://nptel.ac.in/courses/104/106/104106050/
- https://epathshala.nic.in/e-textbook/Class%20XI/Chemistry/ChemistryIEng.pdf

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

Name and Signature of Convener and Members of CBoS



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

PART-A: Introduction				
Program:Bachelors in Science *(Honors/Honors with Research)*			**Semester-VIII**	Session:**2024-25**
1	**Course Code**	**CHSE-09P**		
2	**Course Title**	**SPECTROSCOPY-II LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite(if,any)**	***As per Program***		
5	**Course Learning Outcomes(CLO)**	➢ ***Understand working principle of FTIR instrument and interpret FTIR spectrum.*** ➢ ***Interpretation of H- NMR spectra, Carbon-13 NMR and ESR spectra and identifying molecules based on chemical shifts and coupling constants.*** ➢ ***Interpretation of Mossbauer spectra and understanding its working principle.*** ➢ ***Understanding working principle of mass spectrometry and interpret mass spectrum.***		
6	**Credit Value**	**01Credit**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max.Marks:50**		**MinPassingMarks: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.	**FTIR** • To prepare the KBr pellet of an organic compound (such as benzoic acid). • To carry out a qualitative analysis of an organic compound (such as benzoic acid) using FTIR. • To identify IR absorption peaks and the corresponding functional groups of an unknown solid/liquid/powder. • To study the Optical Rotatory Dispersion (ORD) of some chiral substances.	**30**
	NMR and 13CNMR • To interpret the peaks and identify molecules/structures of NMR spectrums. • To interpret the peaks and identify molecule(s)/structures of ^{13}CNMR spectrums. • To interpret the peaks and identify molecules/structures based on both NMR and ^{13}CNMR spectrums.	
	ESR and Mossbauer • To interpret the peaks and identify the magnetic character of metal/ion based on ESR spectroscopy. • To determine the resonance magnetic field B_0 as function of the selected resonance frequency (v) and the g-factor of DPPH. • To determine the line width δB_0 of the resonance signal. • To interpret and understand the Mössbauer spectra of iron Fe and Sn complexes. • To interpret the peaks (signals) and identify metal/ions based on ESR and	

	Mössbauer spectroscopy.
	Mass Spectrometry • To interpret the mass spectrum and distinguish between different molecules (e.g., alcohols/ethers, aldehydes/ketones, acids, and other aromatic molecules). • To identify the unknown molecule(s) based on combined UV-visible, FTIR, NMR and mass spectrum data.
Keywords	***Vibrational spectroscopy, FTIR, Nuclear Magnetic Resonance (NMR), ^{13}CNMR, Electron spin Resonance (ESR Spectroscopy), Mössbauer spectroscopy, Mass Spectrometry, peaks, signals.***

Signature of Convener & Members (CBoS) :

PART–C

Learning Resources:Text Books, Reference Books and Others

Textbooks Recommended–

1. *Chatwal, G. R., & Sharma, A. (2017). Instrumental Methods of Chemical Analysis. Himalaya Publishing House. Sharma,*
2. *Y. R. (2000). Infrared Spectroscopy: Fundamentals and Applications. Alpha Science Agency.*
3. *Aruldhas, B. R. (2007). Nuclear Magnetic Resonance Spectroscopy. Springer.*

Reference Books Recommended

1. *Vij, D. R. (Ed.). (2007). Handbook of applied solid state spectroscopy. Springer Science & Business Media.*
2. *Guthrie, R. D. (1979). Introduction to Spectroscopy (Pavia, Donald; Lampman, Gary M.; Kriz, George S., Jr.).*
3. *Silverstein, R. M., Bassler, G. C., & Morrill, T. C. (1991). Spec. Identification of Org. Compd. John Wiley.*
4. *Parish, R. V., & Ellis, H. A. (1978). NMR, NQR, EPR and Mossbauer Spectros. in Inorg. Chem. Ellis Horwood.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://www.scribd.com/document/431879132/Lab-Report-3-CHM-260
- https://www.scribd.com/document/68027365/Electron-Spin-Resonance-Experiment
- https://www.intechopen.com/chapters/76771
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Magnetic_Resonance_Spectroscopies/Nuclear_Magnetic_Resonance/NMR%3A_Experimental/NMR_-_Interpretation

Part-D:AssessmentandEvaluation

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 +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**

Signature of Convener & Members CBoS :

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

PART-A: Introduction				
Program: Bachelors in Science *(Certificate/Diploma /Degree/Honors)*			Semester–VIII	Session:2024-25
1	CourseCode	CHSE-10T		
2	CourseTitle	SOLID STATE & NANOMATERIALS CHEMISTRY		
3	CourseType	DSE		
4	Pre-requisite(if,any)	*As per Program*		
5	CourseLearning. Outcomes(CLO)	➢ *Understand the origin and nature of defects and crystals, electrically conducting solids and superconductors.* ➢ *Apply the concept of band theory to explain the behavior of conductors.* ➢ *To compare bulk and nanomaterials, explain the role of size, shape, properties and uses of nanomaterials, describe various methods for synthesis of nanoparticles* ➢ *To describe the instrumentation/principle of various characterization techniques like EDAX, FTIR, SEM, TEM, etc and its application.*		
6	CreditValue	03Credits	*Credit = 15 Hours - learning & Observation*	
7	TotalMarks	Max.Marks:100		MinPassingMarks: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	**Crystal Defects and Non-Stoichiometry** Perfect and imperfect crystals, intrinsic and extrinsic defects-point defects, line and plane defects, vacancies - Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect formation, colourcentres, non-stoichiometry defects. **Organic Solids** Electrically conducting solids, organic charge transfer complex, organic metals, new superconductors.	12
II	**Electronic Properties and Band theory** Metals, insulators and semiconductors, electronic structure of solids – band theory, band structure of metals, insulators, and semiconductors. Intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, super conductors. Optical properties- Optical reflectance, photoconduction - photoelectric effects. Magnetic properties-Classification of materials: Quantum theory of paramagnetism- cooperative phenomena - magnetic domains, hysteresis.	11
III	**Introduction to Nano-materials** Properties and uses of bulk and nano-materials; Optical, electrical and magnetic properties of nano-materials; quantum confinement, role of size and shape in nano-materials. Synthesis of nano-materials Synthesis of nano-crystals by reduction, solvo-thermal synthesis, photochemical synthesis, electrochemical synthesis, semiconductor nano-particles by arrested precipitation. Synthesis of nano-particles by green routes, thermolysis routes and sono-chemical routes, sol-gel, micelle and **micro-**	11

	emulsion methods.	
IV	**Characterization of nano-materials** Instrumentation, operating principle, and application of Energy dispersive X-ray spectroscopy (EDAX); FTIR; X-ray diffraction; Atomic Force Microscope (AFM); Scanning Electron Microscope(SEM); Transmission Electron Microscope (TEM); UV-VIS-IR spectroscopy, Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA) **Applications of Nanomaterials:** Applications of nano in biology, nanoprobes for analytical applications, status of nanobiotechnology, future perspectives of nanobiology; nanosensors.	**11**
Keywords	***Nanomaterials, synthesis, characterization, applications, SEM, TEM, IR, UV-visible, TGA, DTA,nanosensors, nanotechnology.***	

Signature of Convener & Members (CBoS):

PART–C

Learning Resources: Text books, Reference Books and Others

Textbooks Recommended–

1. *Keer, H. V. (1993). Principles Of The Solid State. New Age International.*
2. *Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2006). The Chemistry Of Nanomaterials: Synthesis, Properties and Applications. John Wiley & Sons.*
3. *Kulkarni, S. K., & Kulkarni, S. K. (2015). Synthesis Of Nanomaterials—II (Chemical Methods). Nanotechnology: Principles And Practices, 77-109.*

Reeference Books Recommended–

1. *Hannay, N. B. (1973). Solid state chemistry. In Electronic Materials (pp. 505-534). Boston, MA: Springer US.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://web.mit.edu/robertsilbey/research/papers/1981-1990/rsilbey_structure_properties_organic_solid_state.pdf
- https://chem.libretexts.org/Courses/Howard_University/General_Chemistry%3A_An_Atoms_First_Approach/Unit_5%3A_States_of_Matter/Chapter_12%3A_Solids/Chapter_12.04%3A_Crystal_Defects
- https://jiwaji.edu/pdf/ecourse/chemistry/Electronic%20Properties%20and%20Band%20%20Theory.pdf
- https://www.researchgate.net/publication/259118068_Chapter_-_INTRODUCTION_TO_NANOMATER

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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

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

Name and Signature of Convener and Members of CBoS

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

PART- A: Introduction				
Program: Bachelor in Science *(Honors/Honors with Research)*			**Semester - VIII**	Session: **2024-25**
1	**Course Code**	**CHSE-11T**		
2	**Course Title**	**NATURAL PRODUCTS & MEDICINAL CHEMISTRY**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ *To study the occurrence, types, structure, and analysis methods of terpenes and alkaloids and their biosynthesis* ➢ *To grasp key concepts in medicinal chemistry and drug terminology and learn importance of drug structure for activity.* ➢ *To explore specific drug classes and study the medicinal value of natural products*		
6	**Credit Value**	**3 Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max. Marks: 100**	**Min Passing Marks: 40**	

PART -B: Content of the Course

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

Unit	Topics (Course contents)	No. of Period
I	**Natural Products- Class, Structure and biological importance** Introduction, Natural occurrence, Classification, Uses, general structural features, general methods for structure elucidation including Hoffmann's exhaustive methylation and Emde's method. Terpenes: Isoprene rule Classification of mono- sesqui-, di- and triterpenoids, extraction and biological importance (structure and functions of camphor, citral and α-pinene).	12
II	**Alkaloids and Biosynthesis** Alkaloids: Classification, isolation and biological importance (structure and functions of papaverine, nicotine, coniine). Introduction to biosynthesis: Principles and underlying concepts Building blocks and precursors in biosynthesis (acetate, mevalonate, shikimate, etc.), Enzymatic reactions and their roles in biosynthetic pathways (polyketide synthases, terpene synthases). Biosynthesis of flavonoids and related polyphenols.	11
III	**Introduction to Medicines** Definition of a Medicinal drug, Requirements of an ideal drug, Nomenclature of drugs: Generic name, Brand name, Systematic name Definition of the following medicinal terms: Pharmacon, Pharmacophore, Prodrug, Half-life efficiency, LD50, ED50, Therapeutic Index. (Explanation without including chemistry or structures) Brief idea of the following terms: Receptors, Drug-receptor interaction, Drug Potency, Bioavailability Structure-activity relationships of drug molecules, Quantiative-structure activity relationships (QSAR), binding role of –OH group,-NH_2 group, double bond, and aromatic ring.	11
IV	**Pharmaceutical Compounds** Classification, structure and therapeutic uses of antipyretics - Paracetamol (with	11

	synthesis); Analgesics-Ibuprofen (with synthesis); Antimalarials - Chloroquine (with synthesis); Antitubercular drugs - Isoniazid. An elementary treatment of Antibiotics and detailed study of chloramphenicol, Concept of sedation, hypnotics, and anesthesia Medicinal values of curcumin (haldi), azadirachtin (neem).	
Keywords	***Natural Products, Structure Elucidation, Terpenes & Alkaloids, Medicinal Chemistry, Drug Discovery, Structure-Activity Relationships (SAR), Pharmacokinetics & Pharmacodynamics, Drug Targets, Pharmaceutical Compounds***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Singh, H., & Kapoor, V. K. (1996). Medicinal and Pharmaceutical Chemistry. Vallabh Prakashan.*
2. *Singh, J., Ali, S. M., & Singh, J. (2010). Natural Product Chemistry. Pragati Prakashan.*

Reference Books Recommended –

1. *Finar, I. L., & Finar, A. L. (1998). Organic Chemistry (Vol. 2). Addison-Wesley.*
2. *Foye, W. O., Lemke, T. L., & William, D. A. (1995). Principles of Medicinal Chemistry. B.I. Waverly Pvt. Ltd.*
3. *Hertweck, C. (2012). Natural Product Biosynthesis. Springer-Verlag Berlin Heidelberg.*
4. *Patrick, G. (2017). Introduction to Medicinal Chemistry. Oxford University Press.*

Online Resources–

- https://m.youtube.com/watch?v=H2b-2msgjEE)
- (https://www.genome.jp/kegg/)
- (https://pubchem.ncbi.nlm.nih.gov/)
- (https://onlinecourses.nptel.ac.in/noc23_cy58/preview)
- (https://archive.nptel.ac.in/courses/104/106/104106106/)
- (https://nptel.ac.in/courses/104105076)

Online Resources–

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

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100 Marks

Continuous Internal Assessment (CIA): 30 Marks

End Semester Exam (ESE): 70 Marks

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

Name and Signature of Convener & Members of CBoS:

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

PART- A: Introduction				
Program: Bachelor in Science *(Honors/ Honors with Research)*			**Semester - VIII**	Session: **2024-2025**
1	**Course Code**	**CHSE-11P**		
2	**Course Title**	**NATURAL PRODUCTS AAND MEDICINAL CHEMISTRY LAB. COURSE**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning. Outcomes (CLO)**	➢ ***Demonstrate competence in determining the physicochemical properties of drugs relevant to their biological activity.*** ➢ ***Gain practical experience in the synthesis and characterization of common drugs.*** ➢ ***Develop skills in isolating natural products from plant sources and analyzing their purity.*** ➢ ***Evaluate the antimicrobial potential of natural product extracts or synthetic drugs.*** ➢ ***Integrate theoretical concepts of medicinal chemistry with laboratory techniques.***		
6	**Credit Value**	**1 Credits**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max. Marks: 50**		**Min Passing Marks: 20**

PART -B: Content of the Course		
Total No. of learning-Training/performance Periods: 30 Periods (30 Hours)		
Module	**Topics (Course contents)**	**No. of Period**
Lab./Field Training/ Experiment Contents of Course	Determination the solubility of drug at room temperature Determination of pK_a of drug value by Half Neutralization/ Henderson Hassel Balch equation Determination of Partition of co- efficient of a drug in octanol(other solvent) and water Synthesis and Characterization of some common drugs: paracetamol, Aspirin (Acetylsalicylic Acid) etc Isolation & Characterization: Isolation of the product, determine the yield, and perform characterization using melting point and infrared (IR) spectroscopy. **Antimicrobial Activity Assay:** This practical could involve testing the inhibitory effect of a common antiseptic or a natural product extract on bacterial growth using an agar diffusion assay. Isolation of natural products: Caffeine from Tea Leaves, Pigments from Flowers, Essential Oils from Leaves, Curcumin from Turmeric	**30**
Keywords	***Physicochemical properties, Drug synthesis, Drug characterization, Natural product isolation, Spectroscopy, Antimicrobial activity, Solubility, Partition coefficient***	

Signature of Convener & Members (CBoS) :

PART–C: Learning Resources

Text Books, Reference Books and Others

Text Books Recommended –

1. *Iyengar, M. S. (2009). Pharmacognosy and Phytomedicinal Plants. CRC Press. Organic Chemistry Laboratory Techniques. Pearson Education Limited.*
2. Gupta, Y. K. (2009). **Practical pharmaceutical chemistry - I.** CBS Publishers & Distributors Pvt. Ltd.

Reference Books Recommended –

1. *Stovall, J. C. (2010). Experimental Organic Chemistry: A Miniscale and Microscale Approach. Cengage Learning.*
2. *Martin, A. (2010). Physical Pharmacy (6th ed.). Lippincott Williams & Wilkins.*
3. *Parrott, E. L. (2009). Experimental Pharmaceutics. CRC Press.*

Online Resources–

- **e-Resources / e-books and e-learning portals**
- https://www.ncbi.nlm.nih.gov/books/NBK548557/
- https://www.sigmaaldrich.com/technical-documents/protocols/chemistry/drug-discovery-and-development/partition-coefficient-(log-p)-determination.html
- https://www.sciencedirect.com/science/article/pii/S0022354915332010
- https://www.chm.bris.ac.uk/webprojects2002/sleath/Synthesis.htm
- https://www.michiganstateuniversityonline.com/resources/chemistry/synthesis-and-characterization-of-aspirin/
- https://chem.libretexts.org/Courses/University_of_California_Davis/UCD_Chem_124A%3A_Kauzlarich/Text/04._Infrared_Spectroscopy/4.2%3A_IR_Spectroscopy_Analysis
- https://journals.asm.org/doi/pdf/10.1128/9781555818722.ch15
- https://www.michiganstateuniversityonline.com/resources/chemistry/isolation-of-caffeine-from-tea/
- https://www.life.illinois.edu/mcb/150/SP04/LabManual/natural_products.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** **S. Performed the Task based on lab. work - 20 Marks** **T. Spotting based on tools & technology (written) – 10 Marks** **U. 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: Bachelors in Science *(Honors/Honors with Research)*			**Semester–VIII**	Session:**2024-2025**
1	**Course Code**	**CHSE-12T**		
2	**Course Title**	**INSTRUMENTAL METHODS OF ANALYSIS**		
3	**Course Type**	**DSE**		
4	**Pre-requisite (if, any)**	*As per Program*		
5	**CourseLearning. Outcomes(CLO)**	➢ *Understand the importance of sampling and sample treatment.* ➢ *Select appropriate sampling technique based on sample and target analyte.* ➢ *Explain principle and instrumentation involved in AAS.* ➢ *Deduce the necessity to remove interferences in AAS and methods involved.* ➢ *Select proper technique among the available techniques.* ➢ *Formulate experiments based on optical and electroanalytical techniques.*		
6	**Credit Value**	**03Credits**	*Credit = 15 Hours - learning & Observation*	
7	**Total Marks**	**Max.Marks:100**		**MinPassingMarks:40**

PART-B: Content of the Course

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

Module /Unit	Topics(Coursecontents)	No.of Period
I	**Sampling and sample treatment:** Criteria for representative sample. Techniques of sampling of gases (ambient air and exhaust gases), liquids (water and milk samples), solids (soil and coal samples) and particulates. Hazards in sampling. Safety aspects in handling hazardous chemicals. Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion, fusion processes and dissolution of organic samples. Detection and quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Methods of quantification: Absolute method, comparison method, calibration curve method, standard addition method and internal standard method.	11
II	**Polarography and amperometry** Polarography: Principle of DC polarography. Instrumentation in polarography. Advantages and limitations of DME. Types of currents- residual current, migration current, diffusion current, limiting current, adsorption current, kinetic current and catalytic current. Ilkovic equation-diffusion current constant and capillary characteristics. Derivation of equation of polarographic wave and half wave potential. Experimental determination of half wave potential. Reversible, quasi reversible and irreversible electrode reactions. Polarographic maxima and maximum suppressor. Oxygen interference and deaeration. Introduction to pulse, a.c. and oscillographic techniques and their advantages. Applications of polarography in determination of dissolved oxygen, metal ion quantification and speciation, simultaneous determination of metal ions, analysis of organic compounds. Limitations of polarography.	12

	Amperometric titrations: Principle, types and applications in analytical chemistry.	
III	**Atomic absorption spectroscopy**: Principle. Atomic energy levels. Grotrian diagrams. Population of energy levels. Instrumentation. Sources: Hollow cathode lamp and electrodeless discharge lamp, factors affecting spectral width. Atomizers: Flame atomizers, graphite rod and graphite furnace. Cold vapors and hydride generation techniques. Factors affecting atomization efficiency, flame profile. Monochromators and detectors. Beam modulation. Detection limit and sensitivity. Interferences and their removal. Comparison of AAS and flame emission spectrometry. Applications of AAS.	**11**
IV	**Miscellaneous techniques** **Fluorometry and phosphorimetry:** Principles of fluorescence and phosphorescence. Jablonski diagram. Concentration dependence of fluorescence intensity. Fluorescence quenching. Instrumentation. Applications. **Nephelometry and turbidimetry:** Principle, instrumentation, and applications. **Photoacoustic spectroscopy:** Theory. Instrumentation. Advantages over absorption spectroscopy. Chemical and surface applications of PAS	**11**
Keywords	***Sample, sample treatment, Polarography, Amperometry, Atomic absorption spectroscopy, Instrumentation, fluorometry, Phoshorimetry, Nephelometry, turbidimetry,Photoacoustic spectroscopy.***	

SignatureofConvener & Members (CBoS):

PART–C

LearningResources:Textbooks,ReferenceBooksandOthers

Textbooks Recommended–

1. *Bhatt, B. I., & Vora, S. M. (2008). Stoichiometry (2nd ed.). Tata McGraw-Hill Publishing Company Ltd.*
2. *Chatwal, G., & Anand, S. (2013). Instrumental methods of analysis. Himalaya Publishing House.*
3. *Khopkar, S. M. (2003). Basic concepts in analytical chemistry. New Age International Publishers*

Reference Books Recommended–

1. *Anderson, R. (1986). Sample pre-treatment and separation. John Wiley and Sons.*
2. *Bassett, J., Denney, R. C., Jeffery, G. H., & Mendham, J. (1986). Vogel's textbook of quantitative inorganic analysis. ELBS.*
3. *Braun, R. D. (2004). Instrumental methods of chemical analysis. Tata McGraw-Hill Education.*
4. *Christian, G. D. (2013). Analytical chemistry. Wiley India.*
5. *Day, R. A., & Underwood, A. L. (1986). Quantitative analysis. Prentice-Hall of India.*
6. *Ewing, G. W. (1975). Instrumental methods of chemical analysis. G. W. Ewing.*
7. *Meites, L., & Thomas, H. C. (1977). Advanced analytical chemistry. McGraw-Hill.*
8. *Meites, L., & Thomas, H. C. (1990). Advance analytical chemistry: Meites and Thomas. McGraw-Hill.*
9. *Skoog, D. A., & West, D. M. (1976). Fundamentals of analytical chemistry.*
10. *Shyder, L. R., & Harvath, C. H. (1983). An introduction to separation science. Wiley Interscience.*
11. *Sane, S. S., & Joshi, M. V. (2011). Electroanalytical chemistry. Quest Publications.*
12. *Kolthoff, I. M., & Lingane, J. J. (1952). Polarography.*

OnlineResources–e-Resources/e-booksande-learningportals

- https://people.umass.edu/~mcclemen/581Sampling.html
- https://nptel.ac.in/courses/104105084
- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf

- https://mvpsvktcollege.ac.in/wp-content/uploads/2022/11/1-TYAAS.pdf
- https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/FLUORIMETRY.pdf
- https://courseware.cutm.ac.in/wp-content/uploads/2020/06/nephelometry-and-turbidimetry.pdf
- https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Photoacoustic_Spectroscopy

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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

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

Name and Signature of Convener and Members of CBoS

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

PART-A: Introduction				
Program: Bachelors in Science *(Honors/Honors with Research)*			**Semester-VIII**	Session:**2024-2025**
1	**Course Code**	**CHSE-12P**		
2	**Course Title**	**INSTRUMENTAL METHOD OF ANALYSIS LAB. COURSE-I**		
3	**Course Type**	**DSE**		
4	**Pre-requisite** (if, any)	***As per Program***		
5	**Course Learning Outcomes (CLO)**	➢ *Understanding fundamental principles of polarography and amperometry.* ➢ *Understand the working principle of UV-visible and Atomic absorption spectroscopy.* ➢ *Handling and working with Fluorometer, understanding fluorescence quenching.* ➢ *Handling of flame photometer instrument.* ➢ *To determine concentration of ions in different samples by Nephelo-Turbidometry.*		
6	**Credit Value**	**01Credit**	***Credit =30 Hours Laboratory or Field learning/Training***	
7	**Total Marks**	**Max.Marks:50**		**MinPassingMarks:20**

PART-B: Content ofthe 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.	**Polarography and Amperometry:** • Determination of half wave potential E1/2 and unknown concentration of Cu or Pb or Zn ion. • Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.	**30**
	Absorption spectroscopy: Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy Experiment 7: Atomic Absorption Spectroscopy – Determination of the Amount of Copper and Zinc in a Brass Alloy • Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds. • To determine lambda max (λ_{max}) of phenol and effects of solvents on absorption spectra of phenol. • Assay of paracetamol by UV- Spectrophotometry • To determine the amount of Ca in a sample using the standard calibration curve- Atomic Absorption Spectroscopy (AAS).	
	Fluorimetry and Flame Photometry: • To perform the assay of Riboflavin tablets by fluorimetry • Estimation of quinine sulfate by fluorimetry • Study of quenching of fluorescence • To study the effect of concentration in fluorescence intensity of quinine	

	sulphate solution. • To determination concentration of sodium in given unknown sample by Flame photometry • To determination concentration of potassium in given unknown sample by Flame photometry
	Nephelometry and turbidimetry: • To determine phosphate ion concentration in water sample by Nephelo-Turbidometry. • To determine sulphate and/or chloride ion concentration in water sample by Nephelo-Turbidometry.
Keywords	***Polarography, Amperometry, Absorption Spectroscopy, Fluorimetry, Flame Photometry, Nephelometry, Turbidimetry, Fluorescence, Lambda Max, Absorbance, concentration.***

Signature of Convener & Members (CBoS) :

PART–C,

Learning Resources: TextBooks, Reference Books and Others

Textbooks Recommended–

1. *Sharma, B. K. (1981). Instrumental methods of chemical analysis. Krishna Prakashan Media.*
2. *Badwaik, H. R., Thote L.K.; Giri, T.K. (2022). Practical Handbook: Instrumental methods of analysis. Vallabh Prakashan. Delhi, India.*
3. *Sethi, P. D. (1985). Quantitative analysis of drugs in pharmaceutical formulations. Unique Publishers.*

Reference Books Recommended–

1. *Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. (No Title).*
2. *Stenlake, J. B. (1976). Practical pharmaceutical chemistry. Athlone Press.*

OnlineResources– e-Resources/e-booksande-learningportals

- https://egyankosh.ac.in/bitstream/123456789/43329/1/Unit-8.pdf
- https://mlrip.ac.in/wp-content/uploads/2022/03/INSTRUMENTAL-METHODS-OF-ANALYSIS-LAB-MANUAL.pdf
- https://www.studyandscore.com/studymaterial-detail/flame-photometer-principle-components-working-procedure-applications-advantages-and-disadvantages
- https://www.youtube.com/watch?v=DFQd0Ncj76w
- https://www.studocu.com/en-ie/document/national-university-of-ireland-maynooth/analytical-chemistry/ch202-experiment-7-atomic-absorption-spectroscopy-determination-of-the-amount-of-copper-and-zinc/7019987
- https://www.scribd.com/document/434710621/EXP-4-AAS

PART -D: Assessment and Evaluation

Suggested Continuous Evaluation Methods:

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

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

Name and Signature of Convener & Members of CBoS: