IV Semester

CHEMICAL KINETICS AND CATALYSIS			
Course Code	21BSC51	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

CLO 1	Understand the concepts of kinetics and mechanism.
CLO 2	Explain the various theories of reactions.
CLO 3	Understanding the hypothesis of acidity functions
CLO 4	Evaluate the thermodynamic parameters of adsorption and adsorption isotherms,
CLO 5	Use of industrially important heterogeneous catalysis

Pedagogy (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

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1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1 Reaction Kinetics

A critical account of collision and transition state theories. Kinetics and Mechanism: Steady state approximation and simple examples relating kinetics to mechanism. Theories of unimolecualar reactions: RRKM theory. Isomerisation of methyl isocyanide. Chain Reactions, examples of chain reactions, general aspects of chain reactions. Chain-length, chain transfer reactions, chain inhibition, kinetics of branching chain reactions and explosion limits.

Pedagogy	**Chalk and talk/power point presentation:** A critical account of collision and transition state theories. Kinetics and Mechanism: Steady state approximation and simple examples relating kinetics to mechanism. Theories of unimolecualar reactions: RRKM theory. **Videos/Learning material:** Isomerisation of methyl isocyanide. Chain Reactions, examples of chain reactions, general aspects of chain reactions. Chain-length, chain transfer reactions, chain inhibition. **Self-study:** Kinetics of branching chain reactions and explosion limits.

Module-2 Kinetics in Solution

Effect of solvent, pressure and ionic strength for ion–ion, ion–neutral molecule type reactions and cage effects. Potential energy surfaces, methods employed in the construct of potential surfaces, calculating reactions.

Fast Reactions: Techniques for fast reactions, flow methods, stopped flow technique, relaxation methods and flash photolysis. Numerical problems.

Pedagogy	**Chalk and talk/power point presentation**: Effect of solvent, pressure and ionic

	strength for ion–ion, ion–neutral molecule type reactions and cage effects. Potential energy surfaces, methods employed in the construct of potential surfaces, calculating reactions. **Videos/Learning material**: Fast Reactions: Techniques for fast reactions, flow methods, stopped flow technique, relaxation methods and flash photolysis. Numerical problems. **Self-study:** Flash photolysis
Module-3 Homogeneous Catalysis	
Introduction, general catalytic mechanism: equilibrium treatment and steady-state treatment, activation energies for catalyzed reactions. Acid-Base catalysis: General acid–base catalysis, mechanism of acid-base catalysis, catalytic activity and acid-base strength, salt effects in acid-base catalysis and specific acid-base catalysis: Bronsted relation and linear free energy changes. Acidity functions: Zucker–Hammett hypothesis and Bunnett hypothesis. Enzyme Catalysis: Influence of substrate concentration, pH, temperature and inhibitors. Mechanism of enzyme catalysis: Michaelis–Menten mechanism.	
Pedagogy	**Chalk and talk/power point presentation**: Introduction, general catalytic mechanism: equilibrium treatment and steady-state treatment, activation energies for catalyzed reactions. Acid-Base catalysis: General acid–base catalysis, mechanism of acid-base catalysis, catalytic activity and acid-base strength, salt effects in acid-base catalysis and specific acid-base catalysis: Bronsted relation and linear free energy changes **Videos/Learning material:** Acidity functions: Zucker–Hammett hypothesis and Bunnett hypothesis. Enzyme Catalysis: Influence of substrate concentration, pH, temperature and inhibitors. **Self-study:** Mechanism of enzyme catalysis: Michaelis–Menten mechanism.
Module-4 Adsorption	
The phenomenon of adsorption and thermodynamics of adsorption, adsorption isotherms, Langmuir adsorption isotherm, Langmuir constant and Gibbs energy of adsorption, Langmuir adsorption with lateral interaction, BET adsorption isotherm, Freundlich isotherm and adsorption on heterogeneous surface.	
Pedagogy	**Chalk and talk/power point presentation:** The phenomenon of adsorption and thermodynamics of adsorption, adsorption isotherms, Langmuir adsorption isotherm. **Videos/Learning material**: Langmuir constant and Gibbs energy of adsorption, Langmuir adsorption with lateral interaction. **Self-study:** BET adsorption isotherm, Freundlich isotherm and adsorption on heterogeneous surface.
Module-5 Heterogeneous catalysis	
Catalysis at surfaces, mechanism of heterogeneous catalysis, Transition–state theory of heterogeneous surface reaction: Rates of chemisorptions, rates of desorption, unimolecular and bimolecular surface reactions. Industrial applications of heterogeneous catalysis. Comparison of homogenous and heterogeneous reaction rates.	
Pedagogy	**Chalk and talk/power point presentation**: Catalysis at surfaces, mechanism of heterogeneous catalysis. **Videos/Learning material**: Transition–state theory of heterogeneous surface reaction: Rates of chemisorptions, rates of desorption, unimolecular and bimolecular surface reactions. Industrial applications of heterogeneous catalysis. **Self-study:** Comparison of homogenous and heterogeneous reaction rates.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

CO 1	Discuss the theories of Kinetics of reactions.
CO 2	Explain the mechanism of reactions in solution.
CO 3	Interpret the mechanism of acid-base catalysis.
CO 4	Enumerate the adsorption on heterogeneous surface.
CO 5	Illustrate the unimolecular and bimolecular surface reactions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5thweek of the semester
2. Second test at the end of the 10thweek of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4.First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13thweek of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. **Each question is set for 20 marks**.

2. There will be **2 questions from each module**. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Frost and Pearson: *Kinetics and Reaction Mechanisms*, Wiley, New York
2. Kinetics and Reaction Mechanisms by Frost and Pearson, Wiley, New York
3. P. W. Atkins: *Physical Chemistry* , ELBS, London.
4. G. M. Barrow: *Physical Chemistry,* McGraw Hill, New York. K. J. Laidler: *Chemical Kinetics,* Tata McGraw Hill Publishing Co., New Delhi. 1950.
5. Rajaraman and J. Kuriacose: *Kinetics and mechanism of chemical transformations*, McMillan.
6. S. Glasstone, K. J. Laidler and H. Eyring: *Theory of rate processes*, McGraw- Hill, 1941.
7. K. J. Laidler: *Thoeries of Chemical recation Rates*, McGraw-Hill, 1969
8. S. W. Benson, *The foundations of Chemical Kinetics*,McGraw-Hill,1960.
9. E. S. Amis: *Kinetics of Chemical Changes in Solution*, McMillan, 1948.
10. C. N. Hinshelwood: *The Kinetics of Chemical Change*, Oxford, 1942.
11. R.M. Felder, R.W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
12. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
13. S. S. Dara: *A Textbook of Engineering Chemistry*, S. Chand & Company Ltd. New Delhi.
14. K. De, *Environmental Chemistry*: New Age International Pvt., Ltd, New Delhi.
15. S. M. Khopkar, *Environmental Pollution Analysis*: Wiley Eastern Ltd, New Delhi.
16.S.E. Manahan, *Environmental Chemistry*, CRC Press (2005).

17. G.T. Miller, *Environmental Science* 11th edition. Brooks/ Cole (2006).
18. A. Mishra, *Environmental Studies*. Selective and Scientific Books, New Delhi (2005).

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=Ym3HyZGsOg4&list=PLLy_2iUCG87CZ8WsOQA3WWb1IqAuAlAuB
2. https://www.youtube.com/watch?v=-j1rjB_-DhI

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://demonstrations.wolfram.com/topics.php
- https://interestingengineering.com/science

V Semester

COORDINATION COMPOUNDS AND BIOINORGANIC CHEMISTRY			
Course Code	**21BSC52**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

CLO 1	To understand the nomenclature, isomerism and types in coordination compounds.
CLO 2	To describe various theories to explain the characteristics of coordination compounds.
CLO 3	To contrast the nature of transition elements and their compounds.
CLO 4	To introduce the principles of bioinorganic chemistry and its mechanism.
CLO 5	To know the biological role of nitrogen and trace metals.

Pedagogy (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to convince abstract concepts.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1 Nomenclature of Coordination Compounds

Introduction, IUPAC nomenclature of coordination compounds with examples, isomerism in coordination compounds with examples. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect of polynuclear complexes, Labile and inert complexes.

Pedagogy	**Chalk and talk/power point presentation:** Introduction, Isomerism in coordination compounds with examples. **Videos/Learning material:** Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect of polynuclear complexes, Labile and inert complexes. **Self-study:** IUPAC nomenclature of coordination compounds with examples.

Module-2 Theories of Coordination Chemistry

Werner's theory, Valence bond theory (inner and outer orbital complexes), Electro-neutrality principle and back bonding. Crystal field theory, Measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspects of Ligand field and MO Theory.

Pedagogy	**Chalk and talk/power point presentation**: Werner's theory, Valence bond theory (inner and outer orbital complexes), Electro-neutrality principle and back bonding. Crystal field theory, Measurement of 10 Dq (Δo), CFSE in weak and strong fields,

	pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination. **Videos/Learning material**: Tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. **Self-study:** Qualitative aspects of Ligand field and MO Theory.
Module-3 Transition Elements	
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer diagram). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy) with special reference to the following compounds: potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite.	
Pedagogy	**Chalk and talk/power point presentation**: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. **Videos/Learning material:** Stability of various oxidation states and e.m.f. (Latimer diagram). Chemistry of Ti, V, Cr, Mn, Fe and Co in various oxidation states (excluding their metallurgy) with special reference to the following compounds: potassium dichromate, potassium permanganate, potassium ferrocyanide, potassium ferricyanide, sodium nitroprusside and sodium cobaltinitrite. **Self-study:** Difference between the first, second and third transition series.
Module-4 Bioinorganic Chemistry	
Introduction, Essential and trace elements in biological processes-bulk elements and trace elements, classification of elements according to their action in biological system, Heme proteins: Metalloporphyrins with special references to haemoglobin and myoglobin, Biological role of alkali and alkaline earth metal ion with special reference to Ca^{2+} Role of calcium in muscle contraction; Blood clotting mechanism and biological calcification.	
Pedagogy	**Chalk and talk/power point presentation:** Introduction, Essential and trace elements in biological processes-bulk elements and trace elements, classification of elements according to their action in biological system. **Videos/Learning material**: Heme proteins: Metalloporphyrins with special references to haemoglobin and myoglobin, Blood clotting mechanism and biological calcification. **Self-study:** Biological role of alkali and alkaline earth metal ion with special reference to Ca^{2+} Role of calcium in muscle contraction;
Module-5 Nitrogen Fixation, Metal poisoning and their treatment	
Introduction, Nitrogen in biosphere; Role of micro-organisms in nitrification; Nitrogen fixation-natural and artificial methods used for the fixation of nitrogen, Excess and deficiency of some trace metals, Metal Poisoning-Toxicity of metal ions (Hg, Pb, Cd and As), Reasons for toxicity, treatment by using chelating agents, Platinum complexes in treatment of cancer. Trace Metals in Plant Life: Micronutrients present in soil and their role in plant life;	
Pedagogy	**Chalk and talk/power point presentation:** Introduction, Nitrogen in biosphere; Role of micro-organisms in nitrification; Nitrogen fixation-natural and artificial methods used for the fixation of nitrogen, Excess and deficiency of some trace metals, Metal

	Poisoning-Toxicity of metal ions (Hg, Pb, Cd and As). **Videos/Learning material**: Reasons for toxicity, treatment by using chelating agents, Platinum complexes in treatment of cancer. **Self-study:** Trace Metals in Plant Life: Micronutrients present in soil and their role in plant life;

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO 1	Discuss the theories of Kinetics of reactions.
CO 2	Explore the theories of bonding in coordination compounds and their experimental behaviour.
CO 3	Describe the electronic, catalytic and magnetic properties of the transition metal complexes.
CO 4	Analyze the structure, function and physiology of Haemoglobin and myoglobin.
CO 5	Illustrate the functions and toxicity of elements in biological systems.

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

1. First test at the end of 5thweek of the semester
2. Second test at the end of the 10thweek of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

4.First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13thweek of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

1. The question paper will have ten questions. **Each question is set for 20 marks**.

2. There will be **2 questions from each module**. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Kaim W., and Schewederski, B., Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, New York, USA, 2013.
2. Williams: An Introduction to Bioinorganic Chemistry, C.C. Thomos Spring III.
3. Huheey, J. E., Keiter, E. A. and Keiter, R. L., and Medhi, O. K., Inorganic Chemistry - Principles of Structure and Reactivity,4th edition, Pearson Education, 2006.
4. Lee, J. D. Concise Inorganic Chemistry, Blackwell Science, 5th edition, 1996.
5. Bertini, I., Gray, H. B., Lippard, S. J. and Valentine, J. S., Bioinorganic Chemistry, 1 st South

Asia edition, Viva books Pvt. Ltd., 2007.

6. F. A. Cotton, G. Wilkinson, Advanced Inorganic Chemistry, 6ed, John Wiley, 2004.
7. S.J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry, University Science Books, CA, 1994.
8. B. Douglas, D. McDaniel, J. Alexander, Concepts and Models of Inorganic Chemistry, 3rd Ed, John Wiley, 2001.
9. Robert A. Scott, Charles M. Lukehart, Applications of Physical Methods to Inorganic and Bioinorganic Chemistry, Wiley Publishers, 2007.
10. Wahid Malik, Madan. R.D., and Tuli, G.D. (2004), Selected topics in Inorganic Chemistry. New Delhi. S. Chand & Co.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=REJPwUQDjxA
2. https://www.youtube.com/watch?v=m0Uj7mSC6HU
3. https://www.youtube.com/watch?v=eayeaUT5fus&list=PLFW6lRTa1g83-gUOcT3ay875UG3a9Mu11&index=2

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- https://www.vlab.co.in/broad-area-chemical-sciences
- https://archive.nptel.ac.in/courses/104/104/104104109/
- https://vlab.amrita.edu/index.php/MEC/ENG/WindEnergy/index.php?sub=3&brch=276&sim=1457&cnt=1

V- Semester

Introduction to Quantum Computing			
Course Code	**21BSS531**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:1:0:1	SEE Marks	50
Total Hours of Pedagogy	25	Total Marks	100
Credits	2	Exam Hours	03 Hours

Course Learning Objectives:

This course will develop a student to;

1. Understand the basic principles of quantum computing and information
2. Understand the Quantum Operators and Quantum Gates
3. Understand the basic features of quantum coding and algorithms
4. Understand the Physical Realization of Quantum computers and Quantum error Correction.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills in physics
2. Seminars and Quizzes may be arranged for students in respective subjects to develop skills.
3. Encourage the students to group learning to improve their creativity and analytical skills.
4. While teaching show how every concept can be applied to the real world. This helps the students to expand their understanding level.
5. Support and guide the students for self-study.
6. Ask some higher-order thinking questions in the class, which promotes critical thinking.
7. Inspire the students towards the studies by giving new ideas and examples.

Module-1

Introduction to quantum computing and quantum information **5 Hours**

Introduction to quantum computing, Moore's law & its end, power of quantum computing, differences between classical & quantum computing.

Relationship between quantum information and classical information: bits to qbits, how quantum physics differs from classical physics: single particle interference.

Concept of qubit and its properties. representation of qubit by Bloch sphere. single qubit, two qubits and multiple qubits. computer science perspectives. probability, quantum superposition.

Self-study Component: Qualitative discussion of center of mass, total angular momentum and total kinetic energy of system of particles.

Pedagogy	Chalk and talk, Power point presentation, Videos

Module-2

Dirac representation and matrix operations: **5 Hours**

Complex vector spaces, Hilbert space, basis set, Matrix representation of 0 and 1 States, Identity Operator I, Applying I to$|0\rangle$and $|1\rangle$ states, Pauli Matrices and its operations on $|0\rangle$and $|1\rangle$states, Explanation of i) Conjugate of a matrix and ii) Transpose of a matrix. Unitary matrix U, Examples: Row and Column Matrices and their multiplication (Inner Product), Probability, and Quantum Superposition, normalization rule. Orthogonality, Orthonormality. Numerical Problems.

Self-study Component: Matrix Operations

Pedagogy	Chalk and talk, Powerpoint presentation, Videos

Module-3

Quantum Gates: **5 Hours**

Single Qubit Gates: Quantum Not Gate, Pauli – X, Y and Z Gates, Hadamard Gate, Phase Gate (or S Gate), T Gate, Relationship between Hadamard and T Gate, Relation between S gate and T Gate, **Multiple Qubit Gates:** Controlled gate, CNOT Gate, (Discussion for 4 different input states). Representation of Swap gate, Controlled -Z gate, Toffoli gate. Fredkin Gate, Bell States **Self-study Component: Classical Logic gates**	
Pedagogy	Chalk and talk, Powerpoint presentation, Videos
Module-4	
Features of quantum computing, coding and quantum algorithms **5 Hours** Features of quantum computing: superposition, entanglement, decoherence. Quantum teleportation, no-cloning theorem, super dense coding Quantum algorithms: Deutsch's algorithm, Simon's periodicity algorithm, Grover's search algorithm, Shor's factoring algorithm. Quantum cryptography (qualitative explanation) **Self-study Component: Tensor Product**	
Pedagogy	Chalk and talk, Powerpoint presentation, Videos.
Module-5	
Physical realization of quantum computers and quantum error correction **5 Hours** Physical realization of quantum computers: guiding principles, conditions for quantum computation, harmonic oscillator quantum computer, optical photon quantum computer, ion traps, nuclear magnetic resonance. Quantum error corrections: classical and quantum error correction codes, Shor's 3-qubit bit-flop code, Shor's 9 qubit code. **Self-study Component: Guiding Principles**	
Pedagogy	Chalk and talk, Powerpoint presentation, Videos
Course outcome (Course Skill Set) **Course Outcomes** At the end of course the student will be able to: 1. Describe the principles of Quantum Computing and Information. 2. Elucidate the operators and operations of Quantum Linear Algebra 3. Discuss the Quantum Gates and their operation. 4. Illustrate the Quantum Coding and Algorithms. 5. Realize the Quantum Computers and Quantum Error Correction.	

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Text Books

1. Quantum Computing, Vishal Sahni, Tata McGraw-Hill Publishing, 2007.
2. Quantum Computing by Parag Lala, McGraw-Hill, Indian Edition, Reprint 2020.

Reference Books

1. Quantum computing and Quantum information ,Michael A. Nielsen & Isaac L. Chuang, 10th Anniversary edition, Cambridge University Press, 2010.
2. Quantum Computing for Computer Scientists, Noson S. Yanofsky and Mirco A. Mannucci, Cambridge University Press, 2008.
3. "Thermoelectric Materials Advances and Applications",Enrique Maciá-Barber, PAN Stanford Publishing, CRC Press, Taylor & Francis Group, 2015

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/106106232
2. https://archive.nptel.ac.in/courses/115/101/115101092/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

2. QISKIT : https://qiskit.org/
3. QUIRK: https://algassert.com/quirk

B.Sc. Honors (Physics/Chemistry)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Infinite Series, Fourier analysis and Transforms.			
Course Code	**21BSS533**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

1. Provide basic concepts of sequences and infinite series
2. Understand the basic concepts of Laplace transform and Fourier transform
3. Expand the periodic functions in terms of Fourier series
4. Solve the differential equations by using transform techniques

Pedagogy (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

Module-1: Infinite Series

Convergence and divergence of infinite series of positive real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series**;** Basic comparison test, Limit comparison test, D'Alembert's ratio test.

Self-Study: Cauchy's n^{th}root.

(RBT Levels: L1, L2 and L3) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2: Laplace Transforms

Definition of Laplace transform, Linearity, Laplace transforms of basic functions, derivatives and integrals, Shifting theorems, Change of scale property, Laplace transforms of periodic functions.

Self-Study: Unit step function.

(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-3: Fourier Series	
Periodic function, Dirichlet conditions, Fourier series, Half Range Fourier cosine and sine series, Harmonic analysis. **Self-Study:** The complex form of Fourier series.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-4: Fourier Transforms	
Fourier and inverse Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier sine and cosine transforms, Linearity property, Change of scale property, Shifting property. **Self-Study:** Modulation theorem.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-5: Solution of Equations by Fourier Transforms	
Solution of the integral equation by Fourier sine and cosine transforms, Convolution theorem for Fourier transform, Fourier transform of Partial derivatives, Applications of infinite Fourier transforms to boundary value problems. **Self-Study:** Finite Fourier transform.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome:

At the end of the course, the student will be able to:

- Understand the nature of the series by various tests of an infinite series.
- Laplace transforms and its properties.
- To obtain Fourier series expansion of periodic functions.
- To transform any function into algebraic functions using Fourier transform.
- Solve the boundary value problems by Fourier transform techniques.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks** (**duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

1. James Ward Brown & Ruel V. Churchill (2011). *Fourier Series and Boundary Value Problems*. McGraw-Hill Education.
2. Robert G. Bartle & Donald R. Sherbert (2015). *Introduction to Real Analysis* (4th edition). Wiley India.
3. Charles K. Chui (1992). *An Introduction to Wavelets*. Academic Press.
4. Erwin Kreyszig (2011). *Advanced Engineering Mathematics* (10th edition). Wiley.
5. A. Zygmund (2002). *Trigonometric Series* (3rd edition). Cambridge University Press.
6. J. K. Goyal, K. P. Gupta, Gauri Shankar Gupta (2007). *Integral transforms,* 21st Edition, Pragati Prakashan.
7. B S Grewal (2021). Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

Web links and Video Lectures (e-Resources):

- http://ocw.mit.edu/courses/mathematics/
- http://www.foureir-series.com/
- http://mathworld.wolfram.com/

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Quiz
- Group assignment
- Seminars

V Semester

PHYSICAL AND INORGANIC CHEMISTRY LAB			
Course Code	**21BSCL54**	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	1:0:2:0	SEE Marks	50
Credits	02	Exam Hours	3Hours

CLO1	To interpret, evaluate and report upon observations and experimental results.
CLO2	To know the concepts of kinetics and mechanism.
CLO3	To understand the basic principles of different instrumental techniques.

Sl.NO	Experiments (Any 10 experiments to be conducted)
1	Determination of the Saponification number of oil.
2	Determination of the Iodine number of oil.
3	Estimation of total alkalinity of water samples (CO_3^{2-}, HCO_3^-) using double titration method.
4	Determination of Acid value of fats and oils.
5	Determination of Dissolved Oxygen content in water by Winker's method.
6	Estimation of macro-nutrients: Sodium, Potassium and Calcium in soil samples by flame photometry.
7	Determination of Enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
8	Determination of pKa of poly basic acid with the pH meter.
9	Kinetics of Iodine Clock Reaction.
10	Determination of Critical Micelle Concentration of a Surfactant conductometrically.
11	Study of the solubility of benzoic acid in water and determination of ΔH.
12	Determination of Calorific value of a fuel using Bomb Calorimeter.

Course out comes (Course Skill Set):

At the end of the course the student will be able to:

CO1 Demonstrate the working principles of different instrumental techniques.

CO2 Estimate the Alkalinity, Iodine number, Acid value, CMC of the given analyte by various methods.

CO3 Discuss the kinetics and mechanism of reaction.

Assessment Details (both CIE and SEE)

Continuous Internal Evaluation (CIE): The CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/reports after the conduction of every experiment and one practical test.

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than10-15 per batch.

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.

4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Books:

1. B. Viswanathan and P. S Raghavan, "Practical Physical Chemsitry" 2009.
2. Sunita Rattan, "Experiments in Applied Chemistry", S. K. Kataria & Sons, 2008.
3. Dr. Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Co., 2nd Ed. 2000.
4. Mendham, J., A.I.Vogel's Quantitative Chemical A nalysis 6th Ed., Pearson,2009.
5. Douglas A., Skoog, F., James Holler and Stanley R. Crouch, "Principles of Instrumental Analysis", 6th Ed., 2006.
6. Mary McHale, "General Chemistry Lab", online Book, 2009.

Suggested Learning Resources:

1. http://www.kbcc.cuny.edu/academicDepartments/PHYSCI/PL/chm12/Documents/CHM12_Experiment_5_Kinetics.pdf
2. https://www.youtube.com/watch?v=S9D6tWM49uM
3. https://www.youtube.com/watch?v=TaN1CimEqfY

B.Sc. Honors (Physics/Chemistry/Mathematics)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Subject Name: Concepts of CyberSecurity			
Course Code	**21BSO551**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

- Learn the foundations of Cyber security and threat landscape.
- To equip students with the technical knowledge and skills needed to protect and defend against cyber threats.
- To develop skills in students that can help them plan, implement, and monitor cyber security mechanisms to ensure the protection of information technology assets.
- To expose students to governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security.
- To expose students to responsible use of online social media networks.
- To systematically educate the necessity to understand the impact of cyber crimes and threats with solutions in a global and societal context.
- To select suitable ethical principles and commit to professional responsibilities and human values and contribute value and wealth for the benefit of the society

Pedagogy (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

Module-1: Introduction to Cyber Security

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of Internet, Internet infrastructure for data transfer and governance, Internet Society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

(RBT Levels: L1, L2) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2: Cybercrime and Cyberlaw	
Classification of cyber crimes, Common Cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero-day and zero click attacks, Cybercriminals modus-operandi, Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cybercrime, IT Act 2000 and its amendments.	
(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-3: Social Media Overview and Security	
Introduction to Social Networks. Types of Social media monitoring, hashtags, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social networks, Security reporting of inappropriate content.	
(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-4: E-Commerce and Digital Payments 1	
Definition of E-commerce, Main components of E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stakeholders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD) and Aadhar enabled payments.	
(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-5: Digital Payments-Frauds and Customer Protection	
Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions, Relevant provisions of Payment Settlement Act, 2007.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome:

At the end of the course, the student will be able to:

- Understand the concept of Cyber security and the issues and challenges associated with it
- Understand the cyber crimes, their nature, legal remedies and as to how to report the crimes through available platforms and procedures.
- Appreciate various privacy and security concerns on online social media and understand the reporting procedure of inappropriate content, underlying legal aspects.
- understand the basic concepts related to E-Commerce and digital payments.
- They will become familiar with various digital payment modes and related cyber security aspects, RBI guidelines and preventive measures against digital payment frauds.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks** (**duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

1. Cyber Crime Impact in the New Millennium, by R C Mishra, Auther Press. Edition 2010.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. (First Edition, 2011)
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A Oliver, Create Space Independent Publishing Platform. (person, 13th November, 2001)
4. Electronic Commerce by Elias M Awad, Prentice Hall of India Pvt Ltd.
5. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
6. Network security Bible, Eric Cole, Ronald Krutz, James W Conley, 2nd Edition, Wiley India Pvt. Ltd.
7. Fundamentals of Network Security by E Maiwald, McGraw hill.

Web links and Video Lectures (e-Resources):

- https://www.bing.com/videos/riverview/relatedvideo?&q=introductio9n+to+cyber+security+videos&&mid=9D4475C0E2A498B7D7E09D4475C0E2A498B7D7E0&&FORM=VRDGAR
- https://www.bing.com/videos/riverview/relatedvideo?&q=Architecture+of+cyber+space&&mid=59423C509BEF87F66C5659423C509BEF87F66C56&&FORM=VRDGAR\
- https://www.bing.com/videos/riverview/relatedvideo?&q=classifications+of+cyber+crimes&&mid=A90594668BF86AF7F414A90594668BF86AF7F414&&FORM=VRDGAR
- https://www.bing.com/videos/riverview/relatedvideo?&q=Introduction+to+social+networks&&mid=A253D1EE3D51683C6D28A253D1EE3D51683C6D28&&FORM=VRDGAR

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quiz
- Group assignment
- Seminars

B.Sc. Honors (Physics/Chemistry/Mathematics)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Subject Name: Data Science			
Course Code	**21BSO552**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

1. Understand the knowledge of Mathematics to explain the concept of data science
2. Design Decision tree to predict the class for a given data
3. Analyze the given data set, and solve a problem by performing Classifications using the basics of mathematics and the data science
4. Develop solutions to group entities in the data set and apply it to the given real-world data using the basic knowledge.

Pedagogy (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

Module-1: Introduction

Data-Analytic Thinking: The Ubiquity of Data Opportunities, Example: Hurricane Frances, Example: Predicting Customer Churn. Data Science, Engineering, and Data-Driven Decision Making, Data Processing and Big Data. Data and Data Science Capability as a Strategic Asset, Data-Analytic Thinking.

Text Book 1: Chapter 1

(RBT Levels: L1, L2) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2: Business Problems and Data Science Solutions

From business problems to data mining tasks, supervised versus unsupervised methods, data mining and its results, the data mining process, business understanding, data understanding, data preparation, modelling, evaluation, deployment, and other analytics techniques and technologies: Statistics, database querying, data warehousing, regression analysis, machine learning and data mining.

Text Book 1: Chapter 2

(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-3: Introduction to Predictive Modeling

From correlation to supervised segmentation models, induction and prediction, supervised segmentation, selecting informative attributes example: Attribute selection with information gain, supervised segmentation with Tree-structured models, visualizing segmentations, Trees as sets of rules, probability estimation, Example: Addressing the churn Problem with tree induction

Text Book 1: Chapter 2

(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-4:Fitting of a Model to Data

Classification via Mathematical functions: Linear Discriminant functions, optimizing an Objective function, an example of mining a linear discriminant from data, linear discriminant functions for scoring and ranking instances, support machines briefly, regression via mathematical functions, class probability estimation and logistic regression. Logistic regression: some technical details. Example: Logistic regression versus Tree. Induction, non-linear functions, support vector machines and neural networks.

Text Book 1: Chapter 4

(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-5: Overfitting and its Avoidance:

Fundamental concepts, exemplary techniques, regularization, overfitting, and overfitting examined. From holdout evaluation to cross-validation, the Churn dataset revisited, learning curves, overfitting avoidance and complexity control.

Text Book 1: Chapter 5

(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome:

At the end of the course, the student will be able to:

- Apply the knowledge of mathematics to explain the concept of data science, the available techniques in data science and its scope in business
- Develop a decision tree based on supervised segmentation and predict the class for a given data set by selecting the attribute for segmentation using the available techniques
- Analyze the given data set, and solve a problem by performing classification using the basics of mathematics and data science
- Develop solutions to group entities in data set and apply it for the given real-world data using the basic knowledge.
- Understand the concepts of overfitting and curves.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks** (**duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

Textbooks:

1. Foster Provost and Tom Fawcett. **Data Science for Business**, O'Reilly, 2013. First edition.

Reference Books:

1. Cathy O'Neil and Rachel Schutt, **Doing Data Science**, O'Reilly, 2013
2. Hector Cuesta, **Practical Data Analysis**, PACKT Publishing, 2013,
3. Michel R. Berthold, Christian Borgelt, Frank Hijppner Frank Klawonn, **Guide to Intelligent Data Analysis**, Springer-Verlag London Limited, 2010

Web links and Video Lectures (e-Resources):

- https://www.bing.com/videos/riverview/relatedvideo?&q=data+processing+and+bigdata+videos&&mid=0739E0F892304324175F0739E0F892304324175F&&FORM=VRDGAR
- https://www.bing.com/videos/riverview/relatedvideo?&q=Business+problems+and+data+science+solutions&&mid=0B32390DDED02C33EC900B32390DDED02C33EC90&&FORM=VRDGAR
- https://www.bing.com/videos/riverview/relatedvideo?&q=Predective+modelling+videos&&mid=B7CCA25FFDEB60A52C04B7CCA25FFDEB60A52C04&&FORM=VRDGAR

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quiz
- Group assignment
- Seminars

B.Sc. Honors (Physics/Chemistry/Mathematics)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Subject Name: Food and Nutrition			
Course Code	**21BSO553**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

1. To familiarize students with fundamentals of food, nutrients and their relationship to Health
2. To create awareness with respect to deriving maximum benefit from available food resources
3. Obtain knowledge of different food groups and their nutritive value and role in day's diet.
4. Understand the principles underlying Food Preparation.
5. Develop skills and techniques in Food Preparation with conservation of nutrients and Palatability using cooking methods generally employed.

Pedagogy (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

Module-1: INTRODUCTION TO FOODS

Classification of Food group: Basic 4, 5 and 7 food groups; functional food groups-energy yielding, body building and protective foods (only sources and not properties and functions), food pyramid. Study of various cooking methods - Boiling, steaming, stewing, frying, baking, roasting, broiling, cooking under pressure.

(RBT Levels: L1, L2) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2: CEREALS AND PULSES

Cereals - composition of rice, wheat, effects of cooking on parboiled and raw rice, principles of starch cookery, gelatinization.

Pulses-Varieties of pulses and grams, composition, nutritive value, cooking quality of pulses, germination and its effect.

(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-3: VEGETABLES, FRUITS, MILK AND BEVERAGES

Vegetables - Classification, composition, nutritive value, selection and preparation for cooking, methods and principles involved in cooking.
Fruits -Composition, nutritive value, changes during ripening, methods and effects of cooking, enzymatic browning.
Milk - Composition, nutritive value, kinds of milk, pasteurization and homogenization of milk, changes in milk during heat processing, preparation of cheese and milk powder.
Beverages - Classification, nutritive value, milk-based beverages- methods of preparing tea and coffee, fruit-based beverages and preparation of carbonated non–alcoholic beverages.

(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-4: FATS AND OILS, EGG, MEAT AND MEAT PRODUCTS

Fats and Oils - Types of oils, function of fats and oils, shortening effects of oil, smoking point of oil.
Egg - Structure, composition, selection, nutritive value, uses of egg in cookery, methods of cooking.
Meat and meat products -Structure, composition, nutritive value, selection of meat, post-mortem changes in meat, aging, tenderness. Fish - Structure, composition, nutritive value, selection of fish.

(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-5: NUTRITION

Introduction - General introduction, history of Nutrition. Energy - Definition of Kilocalories, Joule, energy value of foods, determination, physiological fuel values, SDA of foods, basal metabolic rate-definition, factors influencing BMR. Recommended Dietary Allowances for energy. Carbohydrates, Proteins, Vitamins.

(RBT Levels: L1, L2)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome:
At the end of the course, the student will be able to:

- To gain knowledge on food groups and its function, food pyramid and understanding cooking methods.
- To gain knowledge on nutritive value, understand the cookery concepts involved in cereals and pulses.
- To get clear ideas about nutritional classification and understand the changes in pigments of fruits and vegetables apply knowledge on preparation of beverages. To have an overview of the composition, nutritive value and develop skills in the preparation of milk.
- To have an overview of the composition, nutritive value and develop skills in the preparation of egg product and to understand the structure, nutritive value, selection and apply knowledge on methods of cooking fleshy foods and evaluate the uses and abuses of spices and condiments
- To know the history of nutrition and gain ideas on energy and carbohydrates.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

1. Srilakshmi, B., Food Science, (2016), 5th edition, New Age Publishers, India, New Delhi.
2. Srilakshmi, B. (2017) Nutrition Science, New Age International (P) Ltd., New Delhi.
3. Many, S and Shadaksharaswami, M. (2008) Food: Facts and Principles, 3rd edition, New Age Publishers
4. Swaminathan, M., (2012) Food Science, Chemistry and Experimental foods, Bangalore Printing and Publishing Company.
5. Potter M,N. and Hotchkiss, J.H. (1998) Food Science 5th edition, CBS Publications and Distributors, Daryaganji, New Delhi.
6. Philip, T., Modern Cookery for teaching and trade, volume I and II, Orient Longmans Ltd.

Web links and Video Lectures (e-Resources):

- www.nal.vsda.gov/fnic/foodcomp
- www.fda.gov-vegetables
- http://www.eatforhealth.gov.au-fleshfoods,egg&milk
- https://www.business.qld.gov.av-sensoryanalysis of food products
- https://youtu.be/oE8YV2zlO8M

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quiz
- Group assignment
- Seminars

B.Sc. Honors (Physics/Chemistry/Mathematics)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Subject Name: Indian History			
Course Code	**21BSO61**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

1. Learn about ancient India and its importance in present allowance.
2. Rulers of Ancient India and their contribution to Indian art and architecture in nativity.
3. Delhi Sultanate and their contributions, and religious moments of medieval India to enlighten Indian cultural importance.
4. Mughals Administration and their contribution to Indian architecture, Rise of Indian dynasty's against foreign invaders (Europeans).
5. Struggle to establish independent freedom India by our freedom fighters.

Pedagogy (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

Module-1: Ancient India

Ancient India : Sources of ancient Indian history, Indus Valley Civilization and culture, Vedic Civilization and culture, Religious movements of Ancient India (Jainism and Buddhism).

(RBT Levels: L1, L2) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2: Rulers of Ancient India

Rulers of Ancient India : Mauryan Empire - Chandragupta Maurya and Ashoka, Rise of Gupta Empire - Samudragupta and Chandragupta II, Cultural developments in Gupta age, States of South India in brief, Rise of Rajput States - Prithviraj Chauhan, Maharana Pratap. Social and Cultural Development during Rajput Dynasty.

(RBT Levels: L1, L2) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-3: Medieval India	
Medieval India: Banavasi Kadambas - Mayura Varma, Badami Chalukyas - Pulakeshi II, The Rashtrakutas - Amoghavarsha & Hoysalas - Vishnuvardana, Alauddin Khilji, Art and architecture under Sultanate rule, Vijayanagara empire - Krishnadevaraya, Architecture and Literature during Vijayanagara Empire, Religious moments of medieval India (Bhakti saints and sufism) - Acharya's, Ramanand, Kabir, Mirabai, Chaitanya, Guru Nanak).	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-4: Post Medieval India & Advent of the Europeans	
Post Medieval India : Akbar, Shahjahan, Mughal architecture and culture, Nayakas of Keladi - Shivappa nayaka and Rani Chennamma, Mysore Wodeyars - Nalwadi Krishna Raja Wodeyar, Sir M Visvesvaraya, The Mughal and Maratha conflict - Chhatrapati Shivaji, the peshwa's, Advent of the Europeans, Rise of the British - Conquest of Bengal, Battle of Plassey, Battle of Buxar, Anglo Mysore Wars, Anglo Maratha Wars.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-5: The revolt of 1857 to Towards till 1947.	
The revolt of 1857, Economic impact of British rule, Partition of Bengal and Swadeshi movement, Mahatma Gandhi, Civil disobedience movement, Quit India Movement, Impact of the Second World War - 1945-47, Towards freedom - August 15th 1947.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome:

At the end of the course, the student will be able to analyse and understand about:

- Our Ancient India and its importance in present allowance.
- Kings of Ancient India and their contribution to Indian art and architecture.
- Delhi Sultanate and their contributions, religious movements of medieval India to enlighten Indian cultural importance.
- Mughals Administration and their contribution to Indian architecture, Rise of Indian dynasty's against foreign invaders (Europeans).
- Today's Independent freedom India by the efforts of our freedom fighters.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks** (**duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

Text Books:

1. India's Ancient Past, R S Sharma, Oxford University Press, INDIA.
2. A History of Medieval India by Satish Chandra, Orient BlackSwan Pvt. Ltd.; Revised edition (7 July 2020).
3. History of Modern India by Bipan Chandra, Orient BlackSwan Pvt. Ltd.; Revised edition (7 July 2020).

Reference Books:

1. Prehistory and Protohistory of India – An Appraisal by VK Jain, D.K. Print World Ltd; 1st edition (1 June 2006).
2. Ancient History of India by Charles J. Naegele
3. History of Medieval India: From 1000 A. D. To 1707 A. D. by R.S. Chaurasia
4. From Plassey To Partition: A History Of Modern India by Sekhar Bandyopadhyay.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quiz
- Group assignment
- Seminars

B.Sc. Honors (Physics/Chemistry/Mathematics)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Subject Name: Economics			
Course Code	**21BSO562**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

1. This course aims at providing the student with advanced concepts of engineering economic analysis and its role in engineering decision-making.
2. Additionally, the course also covers topics such as depreciation, after tax analysis, replacement analysis, uncertainty, inflation, deflation, and estimation of future events.

Pedagogy (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
2. State the need for Mathematical Science Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity)

Module-1: Introduction to Economics

Nature and Scope of Economics, Basic Concepts in Economics, Micro and Macro Economics, Importance of Study of Economics, Understanding the Economy, Mankiw's ten principles of Economics

(RBT Levels: L1, L2) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-2: Demand and Supply

Demand – Types – Determinants – Law of Demand – Elasticity of Demand – Types – Significance – Supply – Market price determination – Case Study in Demand Forecasting –- Meaning – Methods – Consumer Survey – Trend Projections – Moving average

(RBT Levels: L1, L2 and L3) **5 hours**

Pedagogy	Chalk and talk method/PowerPoint Presentation.

Module-3: Cost, Revenue, Market Structure and Market Failure	
Cost and Revenue: Concepts – Classifications – Short run and long-run cost curves – Revenue – Concepts – Measurement of Profit (Case Study). **Market Structure:** Perfect Competition – Characteristics – Price and output determination in short run and long run – Monopoly – Price Discrimination – Monopolistic Competition – Product Differentiation – Oligopoly and Duopoly. **Market Failure**: Causes – Type of Goods – Rivalrous and Non-rivalrous goods – Excludable and Non-excludable goods – Solutions – Government Intervention.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-4: Money and Banking	
Money – Functions – Quantity theory of money – Banking – Commercial Banks – Functions – Central Bank (RBI) – Functions – Role of Banks in Economic Development.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.
Module-5: Business Cycle and National Income	
Business Cycle and National Income: Meaning –Phases of business cycle - Inflation – Causes – Control measures - Deflation –National Income- Concepts – Methods of calculating national income – Problems in calculating national income.	
(RBT Levels: L1, L2 and L3)	**5 hours**
Pedagogy	Chalk and talk method/PowerPoint Presentation.

Course outcome:

At the end of the course, the student will be able to:

- Describe the role of economics in the decision-making process and perform calculations in regard to interest formulas.
- Estimate the Present, annual and future worth comparisons for cash flows.
- Calculate the rate of return, depreciation charges and income taxes. Enumerate different cost entities in estimation and costing.
- Explain the importance of finance functions, financial ratios and solve related problems.
- Explain the elements of budgeting and benchmarking

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks** (**duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

Text Books:

1. Dewett. K.K., Navalur M. H., "Modern Economic Theory", S. Chand and Company Ltd, New Delhi, 24th Edn., 2014.
2. Lipsey & Chrystal, "Economics", Oxford University Press, 2010

Reference Books:

1. Paul A Samuelson & William, "Economics", Tata McGraw Hill, New Delhi, 2012.
2. Francis Cherinullem "International Economics", McGraw Hill Education, 2011.
3. William A McEachern and Simrit Kaur, "Micro ECON", Cengage Learning, 2013.
4. William A McEachern and Indira A., "Macro ECON", Cengage Learning, 2014.

Web links and Video Lectures (e-Resources):

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quiz
- Group assignment
- Seminars

B.Sc. Honors (Physics/Chemistry/Mathematics)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

SEMESTER - V

Subject Name: Research Methodology			
Course Code	**21BRM57**	CIE	50
Teaching Hours/Week (L: T: P: S)	2:1:0:0	SEE	50
Total Hours of Pedagogy	25	Total	100
Credits	2	Exam Hours	3hrs

Course Learning Objectives:

The course will enable students to:

- Understand the knowledge on basics of research and its types.
- Understand the research design and its concepts.
- Understand methods of research analysis and report preparation.
- To Learn the concept of Literature Review, Pedagogy, Attributions and Citations and learn ethics in research.

Pedagogy (General Instructions)

Teaching-Learning Process (General Instructions) These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not be only the traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video to explain various concepts on IPR.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher Order Thinking) questions in the class, which promotes critical thinking.
5. Introduce Topics in manifold representations.
6. Show the different ways to analyze the research problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the student's understanding.

Module-1

Introduction: Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process.

Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance.

Teaching- Learning Process: Chalk and talk method / PowerPoint Presentation.

(RBT Levels: L1, L2) **5 hours**

Module-2

Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.

Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.

Teaching-Learning Process Chalk and talk method / Power Point Presentation

(RBT Levels: L1, L2) **5 hours**

Module-3

Measurement: Concept of measurement– what is measured? Problems in measurement in research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio.

Sampling: Concepts of Statistical Population, Sample, Sampling Frame, Sampling Error, Sample Size, Non Response. Characteristics of a good sample. Probability Sample – Simple Random Sample, Systematic Sample, Stratified Random Sample & Multi-stage sampling. Determining size of the sample – Practical considerations in sampling and sample size.

Teaching-Learning Process :Chalk and talk method / PowerPoint Presentation

(RBT Levels: L1, L2) **5 hours**

Module-4

Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.

Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Teaching-Learning Process: Chalk and talk method/PowerPoint Presentation

(RBT Levels: L1, L2) **5 hours**

Module-5:

Basic Principles of Design Rights - Use of Encyclopaedias', Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

Use of tools/techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

Teaching-Learning Process: Chalk and talk method / PowerPoint Presentation

(RBT Levels: L1, L2) **5 hours**

Course outcome:

At the end of the course, the student will be able to:

CO 1. To know the fundamentals of research.
CO 2. To know the research design and its concepts.
CO 3. To know the concepts of measurement and saplings.
CO 4. To Understand the data analysis and interpretation.
CO 5. To Understand the tools and techniques for report preparation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester

5. Second assignment at the end of 9th week of the semester
Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hour**)
6. At the end of the 13th week of the semester
The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.
Semester-End Examination:
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**
1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Books Recommended:

Textbook 1. Dr Deepak Chawla & Dr Neena Sondhi "Research Methodology",
ISBN: 9789325982390, Vikas Publishing (2023)
Research Methodology – C.R.Kothari, Edition:2018
Research Methodology (Methods, Approaches and Techniques) by Dr. Baidyanath Mishra published by Choukambha Orientalia, Edition:2018, ISBN:9788176373896

References:

David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488- 4 - Activity Based Learning

Web links and Video Lectures (e-Resources):

https://www.google.com/search?rlz=1C1ASVC_enIN953IN954&q=%22weblinks%22+for+Research+methodology+and+IPR&sa=X&ved=2ahUKEwirt8XRhZiAAxVQb2wGHW9SB6QQ5t4CegQIOhAB
https://www.dolphininstitute.in/workshops-seminars-conducted-on-research-methodology-ipr-and-entrepreneurship/
http://www.cs.princeton.edu/courses/archive/fall02/cs526/

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quiz
- Group assignment
- Seminars