# COMMON ELECTIVE GENERIC / DISCIPLINE SPECIFIC
# FROM THE ACADEMIC YEAR 2023-24

| Sl. No | Sem | Title of the Paper |
|--------|-----|--------------------|
| 1. | III | PRINCIPLES OF ECONOMICS I |
| 2. | IV | PRINCIPLES OF ECONOMICS II |
| 3. | III | PHYSICS – I |
| 4. | IV | PHYSICS – II<br>PHYSICS PRACTICALS – II |
| 5. | III | CHEMISTRY – I |
| 6. | IV | CHEMISTRY – II<br>CHEMISTRY PRACTICALS – II |
| 7. | III | DISCRETE MATHEMATICS I |
| 8. | IV | DISCRETE MATHEMATICS II |
| 9. | III | STATISTICAL METHODS & THEIR APPLICATIONS-I |
| 10. | IV | STATISTICAL METHODS & THEIR APPLICATIONS-II<br>STATISTICAL METHODS & THEIR APPLICATIONS PRACTICALS –II |
| 11. | III | MICROBIOLOGY I |
| 12. | IV | MICROBIOLOGY II<br>MICROBIOLOGY PRACTICALS II |

| PRINCIPLES OF ECONOMICS I |
|---|

**Course Objectives:**

To provide a frame work of knowledge relating to the concepts and practice of Economics in Indian context and to make the students understand the application of Economic principles in the strategic sector. Also, to provide insight on the most pressing issue "Demand for Defence Expenditure" i.e. the right size of Defence Budget.

**Expected Course Outcomes:**

On the successful completion of the course, student will be able to:

| 1 | To learn about an introduction to the discipline of Economics. | K1 |
|---|---|---|
| 2 | Understand about the concepts used in Economics | K2 |
| 3 | Identify the various Mechanisms in economics. | K2 |
| 4 | Acquire knowledge about importance of market forms | K3 |
| 5 | To know about economics related to Defence | K4 |

**K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

| Unit:1 | |  |
|---|---|---|

Economic Analysis - Basic Problems of Economy - Economic Systems - Capitalism - Socialism - Mixed Economy - Communalism - Role of Government.

| Unit:2 | |  |
|---|---|---|

Concept and Management of National Income - Problems of Measurement - Trends in National Income and Planning.

| Unit:3 | |  |
|---|---|---|

Market Mechanism - Law of Demand and Supply - Elasticity of Demand - Elasticity Measurement - Uses - Limitations.

| Unit:4 | | |
|---|---|---|
| Market Forms - Perfect Competition - Monopoly - Discriminative Monopoly - Monopolistic Competition - Wastes of Monopolistic Competition. | | |
| | | |
| Unit:5 | | |
| Defence Economics - Economics of Conflict and Terrorism - Scope and Definition - Micro and Macro Economic impact – International Monetary Organisation – IMF, IBRD, WTO, GATT, TRIPS and TRIMS. | | |
| | | |

| Reference | |
|---|---|
| 1 | Dr. S. Sankaran, Micro Economics. |
| 2 | M.L. Jhingan, Micro Economics |
| 3 | Dutt and Sundaram, Indian Economy. |
| 4 | Defence Economics, |

| Mapping with Programme Outcomes | | | | | |
|---|---|---|---|---|---|
| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | S | M | M | M |
| CO2 | M | M | S | M | M |
| CO3 | S | S | M | S | S |
| CO4 | S | M | S | M | S |
| CO5 | S | M | S | M | S |

*S-Strong; M-Medium; L-Low

| PRINCIPLES OF ECONOMICS II |
|---|

**Course Objectives:**

    To provide a frame work of knowledge relating to the concepts and practice of Economics in Indian context and to make the students understand the theories and growth of Economy in the strategic sector. Also, to provide insight on the most pressing issue "Demand for Defence Expenditure" i.e. the purpose of Defence Budget.

**Expected Course Outcomes:**

On the successful completion of the course, student will be able to:

| 1 | To learn about the basic terms in economics | K1 |
|---|---|---|
| 2 | Understand about the theories and analysis in economics. | K2 |
| 3 | Identify the systems used in economics | K2 |
| 4 | Acquire knowledge about the strategies in economics | K3 |
| 5 | To know about the budget used for Defence purpose | K4 |

**K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

| Unit:1 | | |
|---|---|---|

Money - Functions - Changes in supply of Money, Inflation - Deflation - Types - Characteristics - Causes - Effects - Remedies - Deflationary Gap

| Unit:2 | | |
|---|---|---|

Keynesian Theory of Employment - Savings and Investment Analysis

| Unit:3 | | |
|---|---|---|

Macro-Economic Goals and Tools - Objectives - Central and Commercial Banking in India - Fiscal Policy - Indian Tax System –Recent Trends in Indian Tax Systems.

| Unit:4 | | |
|---|---|---|

Agriculture – Role of Agriculture – Industry – Types – Classification – Role of Industries – Green Revolution – Services Sector.

| Unit:5 | | |
|---|---|---|
| Budget - Salient Features - Central and State - Deficit Financing - Priorities in Budgeting - Expenditure in Defence - Recent Trends in Military Finance - Role of Social and Economic infrastructure for Defence Purposes. | | |
| | | |
| | | |
| **Reference** | | |
| 1 | Dr. S. Sankaran, Macro Economics | |
| 2 | M. L. Jhingan, Macro Economic Theory | |
| 3 | Dutt and Sundaram, Indian Economy | |
| 4 | B. P. Tyagi, Public Economics. | |
| 5 | Dr. S. Sankaran, Monetary Economics | |
| 6 | Chrystal, A, Lipsey, R.G Introduction to Positive Economics, Oxford University | |
| 7 | Garfinkel, M.R. (University of California) Economics of Conflict, An Overview (Paper Presentation). | |
| 8 | Hartley and Sandler, Hand Book of Defence Economics, North Holland | |

| Mapping with Programme Outcomes | | | | | |
|---|---|---|---|---|---|
| COs | PO1 | PO2 | PO3 | PO4 | PO5 |
| CO1 | S | S | M | M | M |
| CO2 | M | M | S | M | M |
| CO3 | S | S | M | S | S |
| CO4 | S | M | S | M | S |
| CO5 | S | M | S | M | S |

*S-Strong; M-Medium; L-Low

| COURSETITLE | PHYSICS – I |
|---|---|
| CREDITS | 3 |
| COURSE OBJECTIVES | To impart basic principles of Physics that which would be helpful for students who have taken programmes other than Physics. |

| UNITS | COURSE DETAILS |
|---|---|
| UNIT-I | **WAVES, OSCILLATIONS AND ULTRASONICS:** Definition of simple harmonic motion (SHM) – laws of transverse vibrations of strings – determination of AC frequency using sonometer (steel and brass wires) – ultrasound – production – piezoelectric method – application of ultrasonics: medical field – lithotripsy, ultrasonography. |
| UNIT-II | **PROPERTIES OF MATTER:** *Elasticity*: elastic constants – bending of beam – theory of non- uniform bending – determination of Young's modulus by non-uniform bending – energy stored in a stretched wire – torsion of a wire – determination of rigidity modulus by torsional pendulum <br> *Viscosity*: streamline and turbulent motion – critical velocity – coefficient of viscosity – Poiseuille's formula – comparison of viscosities – burette method, <br> *Surface tension*: definition– drop weight method – interfacial surface tension. |
| UNIT-III | **HEAT AND THERMODYNAMICS:** Joule-Kelvin effect – Joule-Thomson porous plug experiment – theory – temperature of inversion – liquefaction of Oxygen– Linde's process of liquefaction of air– liquid Oxygen for medical purpose– importance of cryocoolers– entropy – change of entropy in reversible and irreversible process. |
| UNIT-IV | **ELECTRICITY AND MAGNETISM:** potentiometer – principle – measurement of thermo emf using potentiometer –magnetic field due to a current carrying conductor – Biot-Savart's law – field along the axis of the coil carrying current – peak, average and RMS values of ac current and voltage . |
| UNIT-V | **DIGITAL ELECTRONICS AND DIGITAL INDIA:** logic gates, OR, AND, NOT, NAND, NOR , EXOR logic gates – universal building blocks – Boolean algebra – De Morgan's theorem – verification – overview of Government initiatives: software technological parks under MeitY, NIELIT- semiconductor laboratories under Dept. of Space – an introduction to Digital India. |
| PROFESSIONAL COMPONENTS | Expert lectures –seminars — webinars – industry inputs – social accountability – patriotism |
| TEXT BOOKS | 1. R.Murugesan (2001), AlliedPhysics,S. ChandandCo,NewDelhi. <br> 2. BrijlalandN.Subramanyam (1994), WavesandOscillations,VikasPublishing House,NewDelhi. <br> 3. BrijlalandN.Subramaniam (1994), PropertiesofMatter,S.ChandandCo.,NewDelhi. <br> 4. J.B.Rajam and C.L.Arora (1976). Heat and Thermodynamics (8th edition), S.ChandandCo.,New Delhi. <br> 5. R.Murugesan(2005), |

| | |
|---|---|
| | 6. OpticsandSpectroscopy,S.ChandandCo,NewDelhi. A.Subramaniyam, AppliedElectronics2<sup>nd</sup>Edn.,NationalPublishingCo.,Chennai. |
| **REFERENCE BOOKS** | 1. ResnickHallidayandWalker(2018).FundamentalsofPhysics(11$^{th}$edition),JohnWilleyand Sons, Asia Pvt.Ltd., Singapore. 2. V.R.KhannaandR.S.Bedi (1998), TextbookofSound1$^{st}$Edn. KedharnaathPublishandCo, Meerut. 3. N.S.KhareandS.S.Srivastava (1983), ElectricityandMagnetism10$^{th}$Edn.,AtmaRamandSons, New Delhi. 4. D.R.KhannaandH.R. Gulati(1979). Optics,S. Chand andCo.Ltd.,New Delhi. 5. V.K.Metha(2004).Principlesofelectronics6$^{th}$Edn. S.Chandandcompany. |
| **WEB RESOURCES** | 1. https://youtu.be/M_5KYncYNyc 2. https://youtu.be/ljJLJgIvaHY 3. https://youtu.be/7mGqd9HQ_AU 4. https://youtu.be/h5jOAw57OXM 5. https://learningtechnologyofficial.com/category/fluid-mechanics-lab/ 6. http://hyperphysics.phy-astr.gsu.edu/hbase/permot2.htmlhttps://www.youtube.com/watch?v=gT8Nth9NWPMhttps://www.youtube.com/watch?v=9mXOMzUruMQandt=1shttps://www.youtube.com/watch?v=m4u-SuaSu1sandt=3shttps://www.biolinscientific.com/blog/what-are-surfactants-and-how-do-they-work |

**METHOD OF EVALUATION:**

| Continuous InternalAssessment | End Semester Examination | Total | Grade |
|:---:|:---:|:---:|:---:|
| 25 | 75 | 100 | |

**COURSE OUTCOMES:**
Attheendofthecourse,the studentwillbeableto:

| | | |
|---|---|---|
| **COURSE OUTCOMES** | **CO1** | Explain types of motion andextend their knowledge in the study of variousdynamicmotionsanalyzeand demonstrate mathematically. Relate theory with practical applications in medical field. |
| | **CO2** | Explaintheirknowledgeofunderstandingaboutmaterialsandtheir behaviorsandapplyittovarioussituationsinlaboratoryandreal life. Connect droplet theory with Corona transmission. |
| | **CO3** | Comprehend basic concept of thermodynamics concept of entropyand associated theorems able to interpret the process of flowtemperaturephysicsinthebackgroundofgrowthof this technology. |

| | | |
|---|---|---|
| CO4 | Articulate the knowledge about electric current resistance,capacitance in terms of potential electric field and electric correlatetheconnectionbetweenelectricfieldandmagneticfieldan danalyzethemmathematicallyverifycircuitsandapplytheconcepts toconstructcircuitsandstudythem. |
| CO5 | Interpret the real life solutions using AND, OR, NOT basiclogicgatesandintendtheirideastouniversalbuildingblocks. InferoperationsusingBooleanalgebraandacquireelementaryidea sofICcircuits.Acquire information about various Govt. programs/ institutions in this field. |

## MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**L**).

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | S | S | S |
| **CO2** | M | S | S | S | M | S | S | S | S | M |
| **CO3** | M | S | S | S | S | M | S | S | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S | S |
| **CO5** | M | S | S | S | S | S | S | S | S | S |

| COURSETITLE | PHYSICS –II |
|---|---|
| COURSE OBJECTIVES | To understand the basic concepts of optics, modern Physics, concepts of relativity and quantumphysics, semiconductorphysics, and electronics. |

| UNITS | COURSE DETAILS |
|---|---|
| UNIT-I | **OPTICS:** Definition of interference – air wedge – determination of diameter of a thin wire by air wedge – diffraction – diffraction of light vs sound – normal incidence – experimental determination of wavelength using diffraction grating (no theory) – polarization – polarization by double refraction – Brewster's law . |
| UNIT-II | **ATOMIC PHYSICS:** Mass number – atomic number – nucleons – vector atom model – various quantum numbers – Pauli's exclusion principle – electronic configuration – periodic classification of elements –photo electric effect – Einstein's photoelectric equation – applications of photoelectric effect: solar cells,LED, photodiode. |
| UNIT-III | **NUCLEAR PHYSICS:** Magic numbers – shell model – nuclear energy – mass defect – binding energy – radioactivity – uses – half life – mean life - radio isotopes and uses –controlled and uncontrolled chain reaction – nuclear fission – energy released in fission – critical size- atom bomb – nuclear fusion – thermonuclear reactions – differences between fission  and fusion. |
| UNIT-IV | **INTRODUCTION TO RELATIVITY AND GRAVITATIONAL WAVES**: frame of reference – postulates of special theory of relativity – Galilean transformation equations – Lorentz transformation equations – derivation – length contraction – time dilation – twin paradox – mass-energy equivalence. |
| UNIT-V | **SEMICONDUCTOR PHYSICS:** p-n junction diode – forward and reverse biasing – characteristic of diode – zener diode – characteristic of zener diode – voltage regulator – full wave bridge rectifier – construction and working – advantages (no mathematical treatment) – USB cell phone charger –introduction to e-vehicles and EV charging stations. |
| TEXT BOOKS | 1. R.Murugesan (2005), AlliedPhysics,S.ChandandCo,NewDelhi.<br>2. K.ThangarajandD.Jayaraman(2004), AlliedPhysics,PopularBookDepot,Chennai.<br>3. BrijlalandN.Subramanyam(2002), TextbookofOptics,S.ChandandCo,NewDelhi.<br>4. R.Murugesan (2005), ModernPhysics,S.ChandandCo,NewDelhi.<br>5. A.SubramaniyamAppliedElectronics, 2<sup>nd</sup>Edn.,NationalPublishingCo.,Chennai. |
| REFERENCE BOOKS | 1. ResnickHallidayandWalker (2018), FundamentalsofPhysics, 11<sup>th</sup>Edn.,JohnWilleyandSons, Asia Pvt.Ltd.,Singapore.<br>2. D.R.KhannaandH.R. Gulati (1979).Optics, S.ChandandCo.Ltd.,New Delhi.<br>3. A.Beiser (1997), ConceptsofModernPhysics,TataMcGrawHillPublication,NewDelhi. |

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|---|---|---|
| | 4. Thomas L. Floyd (2017), Digital Fundamentals, 11<sup>th</sup>Edn., Universal Book Stall, NewDelhi.<br>5. V.K.Metha(2004), Principlesofelectronics, 6<sup>th</sup>Edn. ,S.Chandand Company, New Delhi. | |
| **WEB RESOURCES** | 1. https://www.berkshire.com/learning-center/delta-p-facemask/https://www.youtube.com/watch?v=QrhxU47gtj4https://www.youtube.com/watch?time_continue=318andv=D38BjgUdL5Uandfeature=emb_logo<br>2. https://www.youtube.com/watch?v=JrRrp5F-Qu4<br>3. https://www.validyne.com/blog/leak-test-using-pressure-transducers/<br>4. https://www.atoptics.co.uk/atoptics/blsky.htm -<br>5. https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects | |

METHOD OF EVALUATION:

| Continuous InternalAssessment | End Semester Examination | Total | Grade |
|---|---|---|---|
| 25 | 75 | 100 | |

COURSE OUTCOMES:
Attheendofthecourse,the studentwillbeableto:

| | | |
|---|---|---|
| **COURSEO UTCOMES** | **CO1** | Explaintheconceptsof interferencediffractionusingprinciplesof superpositionofwaves and rephrase the concept of polarization based on wave patterns |
| | **CO2** | Outline the basic foundation of different atom models and variousexperiments establishing quantum concepts. Relate the importance ofinterpretingimprovingtheoreticalmodelsbasedonobservation. Appreciateinterdisciplinarynatureofscience and in solar energy related applications. |
| | **CO3** | Summarizethepropertiesofnuclei, nuclearforcesstructureofatomicnucleusandnuclear models. Solveproblems on delayratehalf-lifeand mean-life.Interpret nuclear processes likefission and fusion. Understand the importance of nuclear energy, safety measures carried and get our Govt.agencies like DAE guiding the country in the nuclear field. |
| | **CO4** | Todescribethebasicconceptsofrelativitylikeequivalenceprinciple, inertialframes and Lorentz transformation. Extend their knowledge on concepts ofrelativityandvice-versa. Relate this with current research in this field and get an overview of research projects of National and International importance, like LIGO, ICTS, and opportunities available. |
| | **CO5** | Summarize the working of semiconductor devices like junction diode, Zenerdiode, transistors and practical devices we daily use like USB chargers and EV charging stations. |

MAPPING WITH PROGRAM OUT COMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**inthe3-pointscaleofSTRONG(**S**),MEDIUM(**M**)andLOW(**L**).

|      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| CO1  | S   | S   | S   | S   | S   | S   | S   | S   | S   | S    |
| CO2  | M   | S   | S   | S   | M   | S   | S   | S   | S   | M    |
| CO3  | M   | S   | S   | S   | S   | M   | S   | S   | S   | S    |
| CO4  | S   | S   | S   | S   | S   | S   | S   | M   | S   | S    |
| CO5  | M   | S   | S   | S   | S   | S   | S   | S   | S   | S    |

| COURSE | CORE |
|---|---|
| **COURSE TITLE** | **PHYSICS PRACTICALS** |
| **COURSE OBJECTIVES** | Apply various physics concepts to understand properties of matter, light, electricity, and electronics by experimentation to verify theories, quantify and analyses- impart the skill to do error analysis and correlate the results |

**Minimum of 8 Experiments from the list:**

1. Young's modulus by non-uniform bending using pin and microscope.

2. Rigidity modulus by torsional oscillations without mass.

3. Surface tension and interfacial Surface tension – drop weight method.

4. Comparison of viscosities of two liquids – burette method.

5. Determination of g by compound pendulum.

6. Thickness of a wire using air wedge.

7. Refractive index of liquid using liquid prism (hollow prism).

8. Determination of AC frequency using sonometer.

9. Calibration of low range voltmeter using potentiometer.

10. Specific resistance of a wire using PO box.

11. Determination of figure of merit of table galvanometer.

12. Verification of truth tables of basic logic gates using ICs.

13. Characterisation of Zener diode (Forward and Reverse Bias).

14. NAND as universal building block (AND, OR, NOT gates).

15. NOR gate as a universal building block (AND, OR, NOT gates).

*Note* : Use of digital balance permitted

METHOD OF EVALUATION:

| Continuous Internal Assessment | End Semester Examination | Total | Grade |
|---|---|---|---|
| 25 | **75** | **100** | |

# CHEMISTRY - I

| Prerequisites | Higher secondary chemistry |
|---|---|
| Objectives of the course | This course aims to provide knowledge on the<br>• basics of atomic orbitals, chemical bonds, hybridization<br>• concepts of thermodynamics and its applications.<br>• concepts of nuclear chemistry<br>• importance of chemical industries<br>• Qualitative and analytical methods. |
| Course Outline | **UNIT I**<br>**Chemical Bonding and Nuclear Chemistry**<br><br>Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and non-bonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.<br><br>Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes - carbon dating, rock dating and medicinal applications. |

| | **Unit II**<br>**Industrial Chemistry**<br>Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones.<br><br>Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, superphosphate, triple superphosphate. |
|---|---|
| | **UNIT III**<br>**Fundamental Concepts in Organic Chemistry**<br>Hybridization: Orbital overlap, hybridization and geometry of $CH_4$, $C_2H_4$, $C_2H_2$ and $C_6H_6$. Electronic effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric, mesomeric, hyper conjugation and steric- examples.<br><br>Reaction mechanisms: Types of reactions–aromaticity (Huckel's rule) – aromatic electrophilic substitution; nitration, halogenation, Friedel-Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine. |

| | UNIT IV |
|---|---|
| | **Thermodynamics and Phase Equilibria** |
| | Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). |
| | Conditions for spontaneity in terms of entropy and Gibbs free energy. |
| | Relationship between Gibbs free energy and entropy. |
| | Phase Equilibria**:** Phase rule - definition of terms in it. Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag). |

| | UNIT V |
|---|---|
| | **Analytical Chemistry** |
| | Introduction to qualitative and quantitative analysis. Principles of |
| | volumetric analysis. Separation and purification techniques – extraction, |
| | distillation and crystallization. |
| | Chromatography: principle and application of column, paper and thin layer chromatography. |
| Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive examinations UPSC/ JAM /TNPSC others to be solved (To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. V.Veeraiyan, Text book of Ancillary Chemistry; High mount publishing house, Chennai, first edition,2009. |
| | 2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur,2006. |
| | 3. S.ArunBahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, NewDelhi, twenty third edition, 2012. |
| | 4. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninthedition, 2007. |

| Reference Books | 5. P.L.Soni,MohanKatyal,TextbookofInorganicchemistry;SultanChandandCompany,New Delhi, twentieth edition, 2007. |
| | 6. B.R.Puri,L.R.Sharma,M.S.Pathania,TextbookPhysicalChemistry;VishalPublishingCo., New Delhi, fortyfortyseventh edition, 2018. |
| | 7. B.K,Sharma,IndustrialChemistry;GOELpublishinghouse,Meerut,sixteenthedition, 2014. |

**Course Learning Outcomes (for Mapping with POs and PSOs) On completion of the course the students should be able to**

CO 1: gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.

CO 2: evaluate the efficiencies and uses of various fuels and fertilizers

CO 3: explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.

CO 4: apply various thermodynamic principles, systems and phase rule.

CO 5: explain various methods to identify an appropriate method for the separation of chemical components

| CO /PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 |
| Weightage | 15 | 15 | 15 | 15 | 15 |
| Weighted percentage of Course Contribution to POs | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| CO /PO | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 |
| Weightage | 15 | 15 | 15 | 15 | 15 |
| Weighted percentage of Course Contribution to POs | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO's and CO's**

| Title of the Course | CHEMISTRY II |
|---|---|
| Prerequisites | Chemistry for physical sciences -I |
| Objectives of the course | This course aims at providing knowledge on the<br>• Co-ordination Chemistry and Water Technology<br>• Carbohydrates and Amino acids<br>• basics and applications of electrochemistry<br>• basics and applications of kinetics and catalysis<br>• Various photochemical phenomenon |
| Course Outline | **UNIT I**<br>**Co-ordination Chemistry and Water Technology**<br>Co-ordination Chemistry: Definition of terms-IUPAC Nomenclature - Werner'stheory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)4]$, $[Ni(CN)4]^{2-}$,$[Co(CN)6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) – Applications in qualitative and quantitative analysis.<br><br>Water Technology: Hardness of water, determination of hardness of water using EDTA method, zeolite method-Purification techniques- BOD, COD. |
| | **Unit II**<br>**Carbohydrates and Amino acids**<br>Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose –fructose interconversion. Properties of starch and cellulose.<br><br>Amino acids: Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only). |
| | **UNIT III**<br>**Electrochemistry**<br>Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials -electrochemical series. Strong and weak electrolytes - ionic product of water -pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method – buffer solutions and its biological applications - electroplating - Nickel and chrome plating – Types of cells -fuel cells-corrosion and its prevention. |

| | UNIT IV<br>**Kinetics and Catalysis**<br><br>Order and molecularity. Integrated rate expression for I and II (2A $\square$ Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction – Half-life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation. |
| --- | --- |
| | UNIT V<br>**Photochemistry**<br><br>Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples). |
| Extended<br>Professional Component (is a part of internal component only, Not to be included in the external examination question paper) | Questions related to the above topics, from various competitive<br>examinations UPSC/ JAM /TNPSC others to be solved<br>(To be discussed during the Tutorial hours) |
| Skills acquired from this course | Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills. |
| **Recommended Text** | 1. V.Veeraiyan, Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition,2009.<br><br>2. S.Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur,2006.<br><br>3. Arun Bahl, B.S.Bahl, Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition, 2012.<br><br>4. P.L.Soni, H.M.Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007. |
| **Reference Books** | 1. P.L.Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.<br><br>2. R.Puri, L.R.Sharma, M.S.Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018. |

| | 3. B.K,Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014. |
|---|---|
| **Website and e-learning source** | |

**Course Learning Outcomes (for Mapping with POs and PSOs)**
**On completion of the course the students should be able to**
**CO 1:** write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology
**CO 2:** explain the preparation and property of carbohydrate, amino acids and nucleic acids.
**CO 3:** apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.
**CO 4:** identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.
**CO 5:** outline the various type of photochemical process.

| CO /PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to PSOs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| CO /PO | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 |
| **Weightage** | 15 | 15 | 15 | 15 | 15 |
| **Weighted percentage of Course Contribution to POs** | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO's and CO's**

| Title of the Course | CHEMISTRY II Practical |
|---|---|
| Objectives of the course | This course aims to provide knowledge on<br><br>• identification of organic functional groups<br><br>• different types of organic compounds with respect to their properties.<br><br>• determination of elements in organic compounds.. |
| | **SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS**<br>The analysis must be carried out as follows: |
| | (a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].<br>(b) Detection of elements (N, S, Halogens).<br>(c) To distinguish between aliphatic and aromatic compounds.<br>(d) To distinguish – Saturated and unsaturated compounds. |
| Reference Books | V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles ofPractical Chemistry; Sultan Chand & sons, Second edition, 1997. |

**Course Learning Outcomes (for Mapping with POs and PSOs)**
**On completion of the course the students should be able to**
CO 1: gain an understanding of the use of standard flask and volumetric pipettes, burette.
CO 2: design, carry out, record and interpret the results of volumetric titration.
CO 3: apply their skill in the analysis of water/hardness.
CO4: analyze the chemical constituents in allied chemical products

| CO /PSO | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 |
| Weightage | 12 | 12 | 12 | 12 | 12 |
| Weighted percentage of Course Contribution to PSOs | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PSO's and CO's**

| CO /PO | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 |
| Weightage | 12 | 12 | 12 | 12 | 12 |
| Weighted percentage of Course Contribution to POs | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

**Level of Correlation between PO's and CO's**

| Title of the Course | DISCRETE MATHEMATICS-I | |
|---|---|---|
| **Learning Objective** | |
| LO1 | To make the students understand the Mathematical Logic and truth table. | |
| LO2 | To know about how and when to use set theory. | |
| LO3 | To understand the discrete structure, storage structure. | |
| LO4 | To understand the methods of Relations and ordering. | |
| LO5 | To understand the functions, classifications, and types. | |
| **UNIT** | **Contents** | **No. of Hours** |
| I | **Mathematical logic-:** Connectives, well formed formulas, Tautology, Equivalence of formulas, Tautological implications, Duality law, Normal forms. | 12 |
| II | **Set Theory**: Basic Concept of Set Theory – Operations on Sets – Venn Diagram | 12 |
| III | Representation of Discrete Structure : Data Structure – Storage Structure - Sequential Allocation – Pointers and Linked Allocation – An Application of Bit Represented Sets. | 12 |
| IV | **Relations and Ordering:** Relations – Properties of Binary Relations in a set – Relation Matrix and the Graph of a Relation – Partition and Covering of a set – Equivalence Relations – Compatibility Relations – Composition of Binary Relations –Partial Ordering – Partially Ordered set. | 12 |
| V | **Functions** Definitions of functions and its Classification – Types – Examples – Composition of functions – Inverse functions – Binary and n-ary operations – Characteristic function of a set – Hashing functions – Recursive functions | 12 |
| | **Total** | 60 |

| Course Outcomes | | Programme Outcome |
|---|---|---|
| CO | Solve problems in Mathematical logic and truth table. | |
| 1 | Know and understand about set theory. | PO1, PO6 |
| 2 | Know and understand about discrete structure, storage structure. | PO2 |
| 3 | Know and understand about Relations and Ordering | PO4, PO5 |
| 4 | Understand the functions, classification and types. | PO6 |

| Text Book |
|---|
| Discrete Mathematical Structures with applications to computer Science J.P Tremblay and R.P Manohar (Mc.Graw Hill, 1997.) |

| Reference Books |
|---|
| P.R. Vittal,Mathematical Foundations– Margham Publication,Chennai.<br>Discrete Mathematics-Oscar Levin(3rd Edition) |

| Web Resources |
|---|
| https://nptel.ac.in/courses/106106094<br>https://nptel.ac.in/courses/111107058 |

Mapping with Programme Outcomes:

| CO/PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 2 | 3 | 3 | 2 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 2 | 2 | 3 | 3 | 3 |
| **CO 5** | 3 | 2 | 3 | 3 | 3 | 2 |
| **Weight age of course contributed to each PSO** | 15 | 12 | 14 | 15 | 14 | 14 |

S-Strong-3    M-Medium-2  L-Low-1

| Title of the Course | **DISCRETE MATHEMATICS - II** |
|---|---|
| Objectives of the Course | This course aims to develop mathematical maturity and ability to deal with abstraction and to develop construction and verification of formallogical manipulation. |
| Course Outline | UNIT I: RECURRENCE RELATIONS AND GENERATING FUNCTIONS<br>Recurrence - Polynomials and their Evaluations - Recurrence Relations - Solution of Finite Order Homogeneous [linear] Relations - Solutions of Non-homogeneous Relations.<br>(Chap V . Sections:1 to 5 ) |
| | UNIT II: MATHEMATICAL LOGIC<br>TF Statements - Connectives - Atomic and Compound Statements - Well-formed [StatementFormulae]- Truth Table of a Formula-Tautology -Tautological Implications and Equivalence of Formulae.<br>(Chap IX . Sections:1 to 8 ) |
| | UNIT III:  MATHEMATICAL LOGIC [CONTD..]<br>Replacement process - Functionally complete sets of connectives and Duality law – NormalForms-PrincipalNormalForms.(Chap IX . Sections: 9  to 12 ) |
| | UNIT IV:  LATTICES<br>Lattices [omit example 15 PpNo.10.6]- Some properties of          Lattices - New Lattices (omit remark Pp 10.14)-Modular and      Distributive Lattices (omit theorem 10 and 17,Example 4-Pp10.23, Example 11-Pp10.24)<br>(Chap X . Sections:1 to 4 ) |
| | UNIT-V  BOOLEAN ALGEBRA<br>Boolean Algebra (omit theorem 25) - Boolean Polynomials- Karnaugh Maps (omit  K- map for 5 and 6 variables)  (Chap X . Sections:5 to 7) |
| Skills acquired from this course | Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill |
| Recommended Text | M.K.Venkataraman, N.Sridharan and N.Chandrasekaran, [2003] Discrete Mathematics, The National Publishing company, chennai. |
| Reference Books | Oscar Levin, Discrete Mathematics, 3rd Edition,2016.<br>B. A. Davey & H. A. Priestley (2002). *Introduction to Lattices and Order* (2nd edition). Cambridge University Press.<br>Edgar G. Goodaire& Michael M. Parmenter (2018). *Discrete Mathematics withGraph Theory* (3rd edition). Pearson Education.<br>Rudolf Lidl& Günter Pilz (1998). *Applied Abstract Algebra* (2nd edition). Springer.<br>Kenneth H. Rosen (2012). *Discrete Mathematics and its Applications*: *WithCombinatorics and Graph Theory* (7th edition). McGraw-Hill.<br>C. L. Liu (1985). *Elements of Discrete Mathematics* (2nd edition). McGraw-Hill. |
| Website and e-Learning Source | https://nptel.ac.in |

**Course Learning Outcomes**:

This course will enable the students to:

| CO Number | CO Statement | Knowledge Level |
|---|---|---|
| CO1 | Analyse and perceive various graph theoretic concepts and familiarize with their applications. | K4, K5 |
| CO2 | Describe about partially ordered sets, Boolean algebra, lattices and their types. | K1 |
| CO3 | Apply Karnaugh map for simplifying the Boolean expression | K3 |
| CO4 | Demonstrate the skill to construct simple mathematical proofs and to validate. | K2, K6 |
| CO5 | Achieve greater accuracy, clarity of thought and language. | K6 |

| CO | Programme Outcomes (PO) | | | | | | | Programme Specific Outcomes (PSO) | | | | | Mean Scores of COs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| 1 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2.67 |
| 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2.42 |
| 3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2.58 |
| 4 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2.67 |
| 5 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 2.5 |
| | | | | | | | | | | | | Mean Overall Score | 2.57 |
| | | | | | | | | | | | | Result | High |

| Subject Code | Subject Name | Category | L | T | P | S | Inst. hours | Credits | CIA | External | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Statistical Methods and their Applications-I** | Elective | 2 | - | - | - | 4 | 3 | 25 | 75 | 100 |

| | Learning Objectives | |
|---|---|---|
| **LO1** | | Understand basic concepts of Statistical Methods |
| **LO2** | | Have a basic understanding of measures of location |
| **LO3** | | Have a basic understanding of measures of dispersion |
| **LO4** | | Understand about Measures of skewness |
| **LO5** | | Understand about correlation |

| UNIT | | Contents | No. Of. Hours |
|---|---|---|---|
| I | | Introduction - scope and limitations of statistical methods - classification of data -Tabulation of data- Diagrammatic and Graphical representation of data - Graphical determination of Quartiles ,Deciles and Percentiles. | **6** |
| II | | Measures of location: Arithmetic mean, median, mode, geometric mean and Harmonic mean and their properties. | **6** |
| III | | Measures of dispersion: Range, Quartile deviation, mean deviation, Standard deviation, combined Standard deviation, and their relative measures. | **6** |
| IV | | Measures of Skewness: Karl Pearson's, Bowley's, and kelly's and co-efficient of Skewness and kurtosis based on moments. | **6** |
| V | | Correlation - Karl Pearson - Spearman's Rank correlation - concurrent deviation methods.Regression Analysis:Simple Regression Equations. | **6** |
| | | **TOTAL HOURS** | **30** |

| | Course Outcomes | Programme Outcomes |
|---|---|---|
| CO | On completion of this course, students will | |
| CCO1 | Learn the basics of statistical methods | PO1, PO2, PO3, PO4, PO5, PO6 |
| CCO2 | Understanding of measures of location | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO3 | understanding of measures of dispersion | PO1, PO2, PO3, PO4, PO5, PO6 |

| | | | |
|---|---|---|---|
| CCO4 | Understand about Measures of skewness | | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5 | Understand about correlation | | PO1, PO2, PO3, PO4, PO5, PO6 |

| | | |
|---|---|---|
| **Textbooks** | | |
| 1 | | Fundamental of Mathematical Statistics-S.C.Gupta &V.K.Kapoor-SultanChand |
| 2 | | Statistical Methods-Snedecor G.W.& Cochran W.G.oxford &+DII |

| | | |
|---|---|---|
| **Reference Books** | | |
| 1. | | Elements of Statistics -Mode. E.B.-Prentice Hall |
| 2. | | Statistical Methods-Dr.S.P.Gupta-Sultan Chand &Sons |

| | | |
|---|---|---|
| **Web Resources** | | |
| 1. | | https://www.simplilearn.com/what-is-statistical-analysis-article |

**Mapping with Programme Outcomes:**

| CO/PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 2 | 1 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | 2 |
| **CO4** | 3 | 2 | 3 | 2 | 2 | 3 |
| **CO5** | 3 | 2 | 2 | 2 | 3 | 3 |
| **Weightage of course contributed to each PSO** | 15 | 12 | 10 | 11 | 12 | 13 |

**S-Strong-3    M-Medium-2    L-Low-1**

| Subject Code | Subject Name | Category | L | T | P | S | Inst. Hrs | Credit | Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | CIA | Ext | Total |
| | **Statistical Methods and their Applications-II** | Elective | 2 | - | - | - | 3 | 3 | 25 | 75 | 100 |

| | Learning Objectives | |
|---|---|---|
| **LO1** | | Understand basic concepts of curve fitting. |
| **LO2** | | Have a basic understanding of Sample Space |
| **LO3** | | Have a basic understanding of standard distribution |
| **LO4** | | Understand about Test of Significance |
| **LO5** | | Understand about Analysis of variance |

| UNIT | | Contents | No. Of. Hours |
|---|---|---|---|
| I | | Curve fitting by the methods of least squares- $Y= ax+ b, Y= ax2+ bx+ c, Y= axb, Y =a e bx$ and $Y=abx$ | 6 |
| II | | SampleSpace-events-probability-AdditionandMultiplicationTheorem-conditionalprobability - Baye's Theorem. Mathematical expectation Addition and Multiplication theorem,Chebychev's Inequality. | 6 |
| III | | Standard distributions-Binomial, Poisson, Normal distribution and fittingof these distributions. | 6 |
| IV | | Test of Significance-small sample and large sample test based on mean,S.D.correlation and proportion- confidence interval. | 6 |
| V | | Analysis of variance-One and Two way classifications-Basic principle of design of Experiments- Randomisation, Replication and Local control-C.R.D.,R.B.D.and L.S.D | 6 |
| | | **TOTAL HOURS** | **30** |

| | Course Outcomes | Programme Outcomes |
|---|---|---|
| CO | On completion of this course, students will | |
| CCO1 | Learn the basics of curve fitting methods. | PO1, PO2, PO3, PO4, PO5, PO6 |
| CCO2 | Understanding of Sample Space | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO3 | Understanding of standard distribution | PO1, PO2, PO3, PO4, PO5, PO6 |
| CCO4 | Understand about Test of Significance | PO1, PO2, PO3, PO4, PO5, PO6 |
| CO5 | Understand about Analysis of variance | PO1, PO2, PO3, PO4, PO5, PO6 |

| | Textbooks | |
|---|---|---|
| 1 | | Fundamental of Mathematical Statistics-S.C.Gupta &V.K.Kapoor-SultanChand |
| 2 | | Statistical Methods-Snedecor G.W.& Cochran W.G.oxford &+DII |

| | Reference Books | |
|---|---|---|
| 1. | | Elements of Statistics -Mode.E.B.-Prentice Hall |
| 2. | | Statistical Methods-Dr.S.P.Gupta-Sultan Chand &Sons |

**Mapping with Programme Outcomes:**

| CO/PSO | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 1 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 3 |
| CO5 | 3 | 2 | 2 | 2 | 3 | 3 |
| Weightage of course contributed to each PSO | 15 | 12 | 10 | 11 | 12 | 13 |

S-Strong-3        M-Medium-2        L-Low-1

| MICROBIOLOGY I | | | |
|---|---|---|---|
| **Course Objectives** | | | |
| CO1 | Learn the History and Evolution of Microbiology. | | |
| CO2 | Describe the structural organization, morphology and reproduction of microbes. | | |
| CO3 | Explain the methods of cultivation of microbes. | | |
| CO4 | Understand the microscopy and staining techniques | | |
| CO5 | Compare and contrast the different methods of sterilization. | | |
| **UNIT** | **Details** | **No.of Hours** | **Course Objectives** |
| I | History and Evolution of Microbiology, Classification – Three kingdom, five kingdom and eight kingdom. Spontaneous generation – Biogenesis Contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff and Fleming. | 8 | CO1 |
| II | General characteristics of microorganisms -Bacteria, Algae, Fungi, Viruses and Protozoa. Differences between prokaryotic and eukaryotic microorganisms. Anatomy of prokaryotes - cell wall, cytoplasmic membrane, cilia, flagella capsule, cytoplasmic inclusions, sporulation. | 8 | CO2 |
| III | Bacterial culture media and pure culture techniques. Anaerobic culture techniques. | 8 | CO3 |
| IV | Microscopy – Simple, bright field, dark field, phase contrast, fluorescent, electron microscope – TEM & SEM. Staining methods. | 8 | CO4 |
| V | Sterilization - methods of sterilization and Disinfection. Antimicrobial chemotherapy - tests for sensitivity to antimicrobial agents. | 8 | CO5 |
| | Total | 40 | |

| Course Outcomes | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| CO1 | Study the historical events that led to the discoveries and inventions and understand the Classification of Microorganisms. | PO5, PO6, PO10 |
| CO2 | Gain Knowledge of detailed structure and functions of prokaryotic cell organelles. | PO10 |
| CO3 | Understand the various microbiological techniques, different types of media, and techniques involved in culturing microorganisms. | PO11 |
| CO4 | Explain the principles and working mechanism of different microscopes/Microscope, their function and scope of application. | PO4, PO11 |
| CO5 | Understand the concept of asepsis and modes of sterilization and disinfectants. | PO4, PO11 |

| Text Books | |
|---|---|
| 1 | Pelczar. M. J., Chan E.C.S. and Noel. R.K. (2007). Microbiology. 7th Edition., McGraw – Hill, New York. |
| 2 | Willey J., Sherwood L., and Woolverton C. J., (2017). Prescott's Microbiology. 10th Edition., McGraw-Hill International edition. |
| 3 | Salle. A.J (1992). Fundamental Principles of Bacteriology. 7th Edition., McGraw Hill Inc. New York. |
| 4 | Boyd, R.F. (1998). General Microbiology,2nd Edition., Times Mirror, Mosby College Publishing, St Louis. |

| References Books | |
|---|---|
| 1 | Jeffrey C. Pommerville., Alcamo's Fundamentals of Microbiology (9th Edition). Jones &Bartlett learning 2010. |
| 2 | Stanier R.Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5th Edition., MacMillan Press Ltd |
| 3 | Tortora, G.J., Funke, B.R. and, Case, C.L (2013). Microbiology-An Introduction, 11th Edition., Benjamin Cummings. |
| 4 | Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5th Edition., McGraw Hill Publications. |
| 5 | Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co. |

| Web Resources | |
|---|---|
| 1 | https://www.cliffsnotes.com/study-guides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology |
| 2 | https://www.keyence.com/ss/products/microscope/bz-x/study/principle/structure.jsp |
| 3 | https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6604941/# |
| 4 | https://bio.libretexts.org/@go/page/9188 |
| 5 | https://courses.lumenlearning.com/boundless-microbiology/chapter/microbial-nutrition/ |

| Methods of Evaluation | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| Methods of Assessment | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or off beat situations, Discussion, Debating or Presentations | |

## Mapping with Programme Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | M | M | | | | M | |
| CO2 | | | | | | | | | | M | M |
| CO3 | | | | | | | | | | | S |
| CO4 | | | | M | | | | | | | S |
| CO5 | | | | M | | | | | | | S |

| | MICROBIOLOGY II | | |
|---|---|---|---|
| | **Course Objectives** | | |
| CO1 | Learn the Bacterial and Viral diseases. | | |
| CO2 | Understand the Fungal and Protozoan diseases. | | |
| CO3 | Impart knowledge about the Environmental Microbiology. | | |
| CO4 | Acquire knowledge about the Food Microbiology | | |
| CO5 | Familiarize the biofertilizers and biopesticides | | |
| **UNIT** | **Details** | **No.of Hours** | **Course Objectives** |
| I | Bacteria diseases – Symptoms and control of Respiratory Diseases: S. pyogenes, *M. tuberculosis* Gastrointestinal Diseases: *E. coli, S. typhi, Vibrio cholerae*. Fungal diseases - Causative organism, Symptoms and control Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis. | 8 | CO1 |
| II | Viral diseases – Causative organism, Symptoms and control of Polio, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya. Protozoan diseases - Causative organism, Symptoms, mode of transmission and control Malaria, Kala-azar. | 8 | CO2 |
| III | Microbiology of Air – Sources of air borne organisms, Air borne diseases. Water borne diseases; Purification of water. Sewage treatment – Physical, Chemical and Biological methods. | 8 | CO3 |
| IV | Sources of contamination and spoilage of foods; Food Preservation; Fermentation products - Bread and Alcoholic beverages (Beer & Wine); Fermented dairy products – Cheese & Yogurt. SCP- *Spirulina* and Mushroom. | 8 | CO4 |
| V | Biofertilizers – Definition, Types, Importance and Advantages; Nitrogen fixing microorganisms; Phosphate solubilizing microorganisms; Biopesticides | 8 | CO5 |
| | Total | 40 | |

| Course Outcomes | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| CO1 | Gain Knowledge of common bacterial and fungal diseases. | PO5, PO6, PO10 |
| CO2 | Gain Knowledge of common viral and protozoan diseases. | PO10 |
| CO3 | Understand the air, water and waste water microbiology | PO11 |
| CO4 | Understand the food and dairy microbiology | PO4, PO11 |
| CO5 | Utilize the knowledge of biofertilizers and biopesticides. for sustainable agriculture. | PO4, PO11 |

| Text Books | |
|---|---|
| 1 | Kanunga R. (2017). Ananthanarayanan and Panicker's Text book of Microbiology. (10th Edition). Universities Press (India) Pvt. Ltd. |
| 2 | Dubey, R.C. and Maheshwari D.K. (2010).   A Text Book of Microbiology. S. Chand & Co. |
| 3 | Rajan S. (2007). Medical Microbiology.  MJP publisher. |
| 4 | Arora, D. R. and Arora B. B. (2020). Medical Parasitology. (5th Edition). CBS Publishers & Distributors Pvt. Ltd. New Delhi. |
| 5 | Frazier WC and Westhoff DC (2014). Food Microbiology. Tata McGraw Hill Publishing Company Ltd. New Delhi |
| 6 | Subba Rao. N. S. (2017). Soil Microbiology. (5th Edition). MedTech Publishers. |
| 7 | Daniel. C. J. (2006). Environmental Aspects of Microbiology. (2nd Edition). Bright Sun Publications. |

| References Books | |
|---|---|
| 1 | Salle A. J. (2007). Fundamental Principles of Bacteriology. (4th Edition). Tata McGraw-Hill Publications. |
| 2 | Collee J.C. Duguid J.P. Foraser, A.C, Marimon B.P, (1996). Mackie & McCartney Practical Medical Microbiology. 14thedn, Churchill Livingston. |
| 3 | Pepper I. L., Gerba C. P. and Gentry T. J. (2014). Environmental Microbiology (1st Edition). Academic Press, Elsevier. |
| 4 | Bitton, G. (2011). Wastewater Microbiology. (4th Edition). Wiley-Blackwell. |
| 5 | Madigan M.T., Martinko J.M., Stahl D.A, and Clark D. P. (2010). Brock - Biology of Microorganisms, 13th Edition Benjamin-Cummings Pub Co. |

| Web Resources | |
|---|---|
| 1 | http://textbookofbacteriology.net/nd |
| 2 | https://www.adelaide.edu.au/mycology/ |
| 3 | https://en.wikipedia.org/wiki/Virology |
| 4 | www.environmentshumail.blogspot.in/ |
| 5 | http://www.fsis.usda.gov/ |

| Methods of Evaluation | | |
|---|---|---|
| **Internal Evaluation** | Continuous Internal Assessment Test | 25 Marks |
| | Assignments | |
| | Seminars | |
| | Attendance and Class Participation | |
| **External Evaluation** | End Semester Examination | 75 Marks |
| | Total | 100 Marks |
| Methods of Assessment | | |
| **Recall (K1)** | Simple definitions, MCQ, Recall steps, Concept definitions | |
| **Understand/ Comprehend (K2)** | MCQ, True/False, Short essays, Concept explanations, Short summary or overview | |
| **Application (K3)** | Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain | |
| **Analyze (K4)** | Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge | |
| **Evaluate (K5)** | Longer essay/ Evaluation essay, Critique or justify with pros and cons | |
| Create (K6) | Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations | |

## Mapping with Programme Outcomes:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | M | M | | | | M | |
| CO2 | | | | | | | | | | M | M |
| CO3 | | | | | | | | | | | S |
| CO4 | | | | M | | | | | | | S |
| CO5 | | | | M | | | | | | | S |

| MICROBIOLOGY PRACTICAL | |
|---|---|
| **Course Objectives** | |
| CO1 | Acquire knowledge on cleaning of glass wares and sterilization. |
| CO2 | Gain knowledge on media preparation and cultural characteristics. |
| CO3 | Learn the pure culture technique |
| CO4 | Learn the microscopic techniques and staining methods. |
| CO5 | Acquire knowledge to isolate the microorganisms from the environment |

| UNIT | Details |
|---|---|
| I | Cleaning of glass wares, Microbiological good laboratory practice and safety. Sterilization of glass wares and media. |
| II | Media preparation: liquid and solid media. Antibiotic sensitivity testing – Kirby Bauer method |
| III | Pure culture techniques: streak plate, Serial dilution – spread plate and pour plate. |
| IV | Staining techniques: smear preparation, simple staining and Gram's staining. Motility demonstration – Hanging drop technique. Fungal identification by Lactophenol cotton blue staining technique. |
| V | Isolation of microorganisms from air, soil and sewage. Testing the quality of milk - MBRT |

| **Course Outcomes** | | |
|---|---|---|
| **Course Outcomes** | On completion of this course, students will; | |
| CO1 | Practice sterilization methods | PO4, PO7, PO8, PO9, PO11 |
| CO2 | Learn to prepare different media and their quality control. | PO4, PO7, PO8, PO9 |
| CO3 | Learn streak plate, pour plate and serial dilution and pigment production of microbes. | PO4, PO7, PO8, PO9, PO11 |
| CO4 | Understand Microscopy methods, different Staining techniques and motility test. | PO4, PO7, PO8, PO9 |
| CO5 | Acquire knowledge to isolate bacteria from the environment | PO4, PO7, PO8, PO9 |

| **Text Books** | |
|---|---|
| 1 | James G Cappucino and N. Sherman MB (1996). A lab manual Benjamin Cummins, New York 1996. |
| 2 | Kannan. N (1996). Laboratory manual in General Microbiology. Palani Publications. |
| 3 | Sundararaj T (2005). Microbiology Lab Manual (1$^{st}$ edition) publications. |
| 4 | Gunasekaran, P. (1996). Laboratory manual in Microbiology. New Age International Ld., Publishers, New Delhi. |
| 5 | R C Dubey and D K Maheswari (2002). Practical Microbiology. S. Chand Publishing. |
| **References Books** | |

| | | |
|---|---|---|
| 1 | Atlas. R (1997). Principles of Microbiology, $2^{nd}$ Edition, WM.C.Brown publishers. | |
| 2 | Amita J, Jyotsna A and Vimala V (2018). Microbiology Practical Manual. ($1^{st}$ Edition). Elsevier India | |
| 3 | Talib VH (2019). Handbook Medical Laboratory Technology. ($2^{nd}$ Edition). CBS | |
| 4 | Wheelis M, (2010). Principles of Modern Microbiology, 1st Edition. Jones and Bartlett Publication. | |
| 5 | Lim D. (1998). Microbiology, $2^{nd}$ Edition, WCB McGraw Hill Publications. | |
| **Web Resources** | | |
| 1 | http://www.biologydiscussion.com/micro-biology/sterilisation-and-disinfection-methods-and-principles-microbiology/24403. | |
| 2 | https://www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635 | |
| 3 | https://www.grsmu.by/files/file/university/cafedry//files/essential_microbiology.pdf | |
| 4 | https://microbiologyinfo.com/top-and-best-microbiology-books/ | |
| 5 | https://www.cliffsnotes.com/studyguides/biology/microbiology/introduction-to-microbiology/a-brief-history-of-microbiology | |

**Mapping with Programme Outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | M | | | L | M | L | | M |
| CO2 | | | | S | | | L | L | L | | |
| CO3 | | | | S | | | M | M | L | | M |
| CO4 | | | | S | | | M | L | L | | |
| CO5 | | | | S | | | M | L | L | | |

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