

**F. Y. B. Sc. (CBCS – 2018 Course)**  
**SEM. - I**  
**P - 11: MECHANICS & PROPERTIES OF MATTER**

**Total Credits: 03**

**Total Lectures: 45**

**Course Learning Outcomes:**

By the end of this course student will be able to have following learning outcomes,

- Basics of mechanics and related dynamics
- To understand Newton's laws of motion
- To know Kepler's laws
- Different forces those exist in nature and their physical significance
- Conservation of energy and their dynamics
- Deep knowledge of physical quantities such as Elasticity, Viscosity and Surface Tension
- Capacity to investigate and analyze the daily problems related to mechanical movement

**Course Content:**

**1. NEWTON'S LAWS OF MOTION:**

Revision of Laws of motion, Various types of forces in nature (explanation) and concept of field, Equation of motion of a particle with different form of forces, Frame of reference (Inertial, Noninertial), Pseudo Forces (e.g. Centrifugal Force), Kepler's laws (only statements)

**2. MECHANICS OF PARTICLES**

Kinetic Energy of particle in translational and rotational motion, Work and Work-Energy Theorem, Calculation of Work done with Constant Force, Variable Force with Illustration, Conservative and Non-conservative Forces, Potential energy and conservation of Mechanical energy, Mass-energy equivalence,

**3. ELASTICITY**

Revision of stress, strain and Hook's law, Poisson's ratio, its limiting values, Elastic constant for isotropic solid, Relation between Young modulus, Bulk Modulus and Modulus of elasticity (without derivation), Torsion of a cylinder (wire) and Torsional rigidity, To determine  $\mu$  by torsional oscillations, Bending of beam, Bending moment and shear force, bending equation, Cantilever: Beam supported at both the ends and loaded at the centre (double cantilever)

**4. VISCOSITY**

Revision of Viscosity, Viscous fields and viscous force, Streamline flow and turbulent flow, streamline flow of liquid through capillary tube: Poisculle's equation, Comparison of viscosities of liquids by Ostwald's viscometer. Effect of temperature on viscosity, Study of variation of viscosity with temperature, Bernoulli's Principle (Without Proof), Application of Bernoulli's equation i) Speed of Efflux, ii) Ventury meter, iii) Aspirator Pump, iv) Change of plane of motion of a spinning ball.

## **5. SURFACE TENSION**

Revision of Surface tension, angle contact, concept of surface tension as surface energy, surface tension by Jaeger's method, Ferguson method, Factors affecting surface tension, Applications of surface tension.

### **TEXT AND REFERENCE BOOKS**

1. R. P. Feynman, R. B. Leighton M. Sands, " The Feynman Lectures on Physics" Vol. I (B. 1. publications, Bombay, Delhi, Calcutta, Madras).
2. Problems in Physics: P.K. Srivastava, Wiley Eastern Ltd
3. D. S. Mathur " General Properties of Matter" (Shamlal Charitable Trust, New Delhi)
4. D. Halliday and R. Resnik, " Physics Part V.
5. B. Gupta, College Physics Volume 1, Book's and Allied (P) Ltd.
6. H.C. Varma, "Concept of Physics", (Bharati Bhavan Publisher)
7. Properties of Matter: D. S. Mathur, Shamlal Charitable Trust New Delhi
8. Mechanics: D.S Mathur, S Chand and Company New Delhi-5.

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**F. Y. B. Sc. (CBCS – 2018 Course)**

**SEM. – I**

**P-12: MODERN PHYSICS**

**Total Credits: 03**

**Total Lectures: 45**

**Course Learning Outcomes:**

By the end of this course student will be able to have following learning outcomes,

- Understanding of atomic and nuclei structures as well as their history
- Properties of electromagnetic waves and their dynamics.
- Use of electromagnetic wave spectrum and associated breakthrough research such as Planck's hypothesis
- Student will be able to understand how technological equipment uses electromagnetic waves and has various applications in our day to day life.
- Understanding of how LASER works, what Physics is associated with it and various applications of LASER
- Ability to explain molecular Physics and underlying basic concepts.
- Understanding of renewable energy sources and application of solar cell and their various application

**Course Content:**

**1. ATOMS AND NUCLEI**

Bohr's hydrogen atomic Model (revision), Bohr's correspondence principle, discovery of neutron, Frank and Hertz experiment, Composition of nucleus, concept of mass defect and binding energy with curve, packing fraction

**2. ELECTROMAGNETIC WAVES**

Prospective of electromagnetic waves with characteristics, electromagnetic spectrum, Planks hypothesis of photons, electromagnetic waves: Radio waves, Microwave, Infrared, Visible light, Ultraviolet, X-rays and Gamma rays with properties, Applications: microwave oven, RADAR, Pyroelectric thermometer, X-ray radiography and CT scan.

**3. LASER**

Introduction to Lasers, properties of laser, principle with absorption, spontaneous emission and stimulated emission, optical pumping, population inversion, laser action and applications

**4. PHYSICS OF MOLECULES**

Bonding mechanism: A Survey of Ionic bond, Covalent bonds, Van der Waals bonds, Metallic bonds and Hydrogen bond, Concept of electrostatic potential with potential energy, Variation of potential energy with inter-atomic distance

**5. RENEWABLE ENERGY SOURCES**

Need and importance of energy sources, Different Renewable energy sources, Solar energy as a principle source, solar cell: Photovoltaic principle, construction and working of solar cell, I-V characteristics, Fill factor, efficiency of solar cell and applications.

**Text and reference books**

1. J. B. Rajan, "Atomic Physics"
2. A. Beiser, "Prospective of Modern Physics"
3. H. S. Mani and G. K. Mehata, "Introduction to Modern Physics"
4. F. K. Richtmayer, "Modern Physics"
5. S. P. Sukhatme, "Solar Energy"
6. D. O. Hall and R. P. Overend, "Biomass-Renewable energy"
7. S.K.Kulkarni, Nanotechnology: Principles and Practices

**F. Y. B. Sc. (CBCS – 2018 Course)**  
**SEM. - I**  
**P - 13: Practical Course -I**

**Total Credits: 02**

**Learning Outcome :**

By the end of this course student will be able to have following learning outcomes,

1. Study of basic instruments like Vernier caliper, micrometer screw gauge, traveling microscope, spectrometer etc..
2. Study of Surface tension and viscosity.
3. Measurement of moment of inertia and modulus of rigidity
4. To understand kirchoff's laws and measurement of capacity of condenser
5. To know diode characteristic and vector diagram of L-R circuit

**Course Content:**

1. Basic study of instruments (Vernier caliper, micrometer screw gauge, traveling microscope, spectrometer etc.) with least count, error analysis and range
2. Viscosity by flow through capillary tube (Poiseulle's method)
3. M. I. of disc by Torsional oscillations and  $\eta$  - by torsional pendulum
4. M.I. of Flywheel
5. Poisson's ratio by rubber and cord method
6. Surface tension of water by Jaeger's method
7. Verification of Kirchoff's laws
8. Charging and discharging of condenser
9. Vector diagram of L-R circuit and power factor
10. Study of inductive reactance
11. Diode characteristics
12. Study of Analog/digital multi-meter
13. Comparison of capacitances (De-Sauty's method)

Note: Any eight (8) experiments should be performed.

**Text and reference books:**

1. B. L. Worsnop and H. T. Flint, " Advanced Practical in Physics"
2. D. P. Khandewal, " Laboratory manual for Physics for Undergraduate students"
3. B. Saraf, " Physics through experiments, vol. II

**F. Y. B.Sc. (CBCS-2018 COURSE)**  
**SEMESTER – I**  
**C-11: PHYSICAL & INORGANIC CHEMISTRY-I**  
**Total Credits: 03** **Total Lectures: 45**

**Course Learning Outcomes:**

After completion of this course students should be able to:

1. Understand the kinetics of various chemical reactions.
2. Apply the concept of distribution law to different chemical processes.
1. 3 Know the applications of differential calculus and integral calculus.
2. 4. Understand units of concentrations w.r.t. primary and secondary standards.
6. Find out oxidation state and use it in problem solving.

**Course Content:**

**SECTION – I (PHYSICAL CHEMISTRY)**

**1. Chemical Kinetics**

Chemical kinetics and its scopes, Measurement of Reaction rate, Order and Molecularity of reaction, First Order Reactions, Properties of first order reactions, Examples of first order reactions.

Second order reactions, Properties of second order of reactions, examples of second order reactions.

Third order reactions, Properties of third order reactions, Pseudo- unimolecular reactions. Numericals.

**Ref. 8** Page No. 548-564

**2. Distribution Law**

Introduction, Nerst distribution law, statement and thermodynamic proof for Nerst distribution law, limitations of distribution law, Association and dissociation of solute in solvent, Application of distribution law, Numericals.

**Ref. 10** Page No. 743-772

**3. Basics of Chemical Mathematics**

**Logarithms:** Definition and rules of logarithms without derivation, Application of logarithm to pH, pOH, pK and solving numerical problems.

**Graphical Representation:** Equation of straight line, Plotting of graph, Meaning and significance of slope and intercept, Plotting of graph using chemical equations.

**Differentiation:** Definition and meaning of derivative, Rules of differentiation and partial differentiation pertaining to algebraic, logarithmic and exponential functions without proof, examples related to chemistry.

**Integration:** Rules of integration pertaining to algebraic and exponential functions without proof, examples related to chemistry.

**Ref. 11** Page No. 93-187

## REFERENCES:

1. Physical Chemistry by G. M. Barrow  
Fifth Edition (McGraw-Hill) (2007)
2. Physical Chemistry by Robert G Mortimer  
Third Edition, Elsevier (2008)
3. Physical Chemistry by Atkins and Paula  
8<sup>th</sup> Edition (2008)
4. College Chemistry by Barua, Bijoy and Y. R. Sharma  
Kalyani Publishers (1995)
5. Principles of Physical Chemistry by Puri, Sharma and Pathania, Vishal publishing  
Company (2008)
6. Physical Chemistry by Dr. S. Pahari  
New Central book agency (P) Ltd. (2007)
7. Physical Chemistry by Ira N. Levine  
Fifth Edition Tata McgGaw-Hill (2004)
8. Principles of Physical Chemistry by Maron and Prutton  
4<sup>th</sup> Edition (2008)  
Oxford IBM Publishing Co. Pvt. Ltd.
9. Advanced Physical Chemistry by D. N. Bajpai  
S. Chand (2011)
10. Essentials of Physical Chemistry by Arun Bahl, B. S. Bahl and  
G. D. Tuli  
S. Chand (2012)
11. The Chemistry of Maths Book by Erich Steiner,  
Oxford University Press, 2<sup>nd</sup> edition, Reprint (2011)
12. Physical chemistry N. Kundu and S.K.Jain,S.Chand & company Ltd New Delhi.  
First edition 1984, reprint 1990
13. Physical Chemistry, A Molecular approach.Donald A. Mc Quarrie and John  
D.Simon, Published by University Science Books CA, USA.First edition 1998,  
reprint 2006

## SECTION – II (INORGANIC CHEMISTRY)

### 1. Mole Concept and Stoichiometry

Mole concept-Determination of mol. Weight by gram molecular volume relationship, problems based on mole concept. Methods of expressing concentrations, strength, normality, molarity, molality, % w/v, % v/v, ppm, standardization of solutions, primary & secondary standard substances, Preparation of standard solution of acids & bases, problems related to acid base titrations only.

[Ref. 1,2]

### 2. Oxidation & reduction

Definitions of the related terms like oxidation, reduction, oxidizing agent, reducing agent, oxidation number, Balancing of redox reactions using oxidation number method & ion electron method, problems based one equivalent weight of oxidant & reluctant.

[Ref.1,2]

### REFERENCES:

1. General Chemistry - Raymond Chang, Kenneth A. Goldsb, McGraw-Hill ; 11th edition ( 2012)
2. General and Inorganic Chemistry, R.P. Sarkar, Part-I, New Central book agency LTD, London, Third Edn (2011), P 383-461.



**F. Y. B.Sc. (CBCS-2018 COURSE)**  
**SEMESTER - I**  
**C-12: ORGANIC & INORGANIC CHEMISTRY-I**

**Total Credits: 03**

**Total Lectures: 45**

**Course Learning Outcomes:**

After completion of this course students should be able to:

1. Understand the Structural effects , types of organic reaction and meaning of electrophiles & nucleophiles.
2. Write generation, structure, stability and reactions of carbocations, carbanions& free radicals.
3. Explain theHuckel's rule, Reactions and mechanism of Nitration, Sulphonation, Halogenation and Friedel – craft reactions.
4. Know synthesis and reactions of Aldehydes & ketones.
5. Describe periodic table, properties, compounds and applications of S-block elements.

**Course Content:**

**SECTION – I (ORGANIC CHEMISTRY)**

**1) INTRODUCTION TO ORGANIC CHEMISTRY**

**Development of Organic Chemistry: -**

Unique properties of organic compounds, sources of organic compounds and applications of organic compounds.

**Structural effects: -**

Inductive, Resonance, Hyper conjugative and steric effects and their effects on strength of acids and bases.

**Bond fission: -**

Homolysis & Heterolysis.

**Types of Organic Reaction: -**

Substitution, Addition, Elimination and Rearrangement with one example of each.

**Types of Reagents: -**

Electrophilic and Nucleophilic reagents (Definition & examples)

[Ref. 3, Pages 18-25.]

**2) FUNDAMENTALS OF ORGANIC REACTION MECHANISM**

**Reactive Intermediates:**

**Carbocation :** Introduction, generation, structure, stability, elimination of a proton, reaction with nucleophiles, addition to unsaturated compounds and molecular rearrangement.

**Carbanions:** Introduction, generation, structure, stability, reactions-, displacement and rearrangement.

**Free Radicals:** Introduction, generation-photolysis, thermolysis and redox Reaction, stability, reaction - recombination, disproportionate, reaction with olefins and rearrangements.

[Ref. 4, Pages. 78 – 121]

### 3) AROMATIC COMPOUNDS

Aliphatic and Aromatic Compounds, Structure of Benzene, Kekule's structure, stability of benzene, Aromatic character, Huckel's rule, Reactions and mechanism of Nitration, Sulphonation, Halogenation and Friedel – craft reaction.

[Ref. 1, Pages 209-216.]

### 4) ALDEHYDES AND KETONES

Synthesis of Aldehydes:- From alcohols, methyl benzenes, acid chlorides and phenols. Synthesis of ketones from alcohols, carboxylic acids, acid chlorides & nitriles.

(i) Grignard reagent

(ii) Wittig reaction

(iii) Reduction reactions – Catalytic reduction,  $\text{LiAlH}_4$ ,  $\text{NaBH}_4$ , Clemmensen, Wolf – Kishner.

(iv) Cannizzaro's reaction (v) Perkins reaction (vi) Aldol Condensation

(vii) Analysis of aldehydes and ketones.

[ Ref. 1, Pages 291-236.]

### REFERENCES:

1. Organic Chemistry (Sixth Edition) by Robert Morrison and Robert Boyd. Prentice Hall of India Pvt. Ltd. New Delhi (1989).
2. Guide book to mechanism in organic chemistry (Sixth Edition) by Peter Sykes, Orient Longman (1981).
3. Organic Chemistry by Francies A. Carey (Sixth Edition), McGraw Hill book Company (1987).
4. Organic Reaction Mechanism (Third edition), by V.K. Ahluwalia, Narosa publishing house ,Mumbai.
5. Textbook of Organic Chemistry (Fifth Edition ) by Raj K. Bansal - New Age International (P) Ltd. Publishers, Mumbai (2007)

## SECTION – II (INORGANIC CHEMISTRY)

### 1. Chemistry of s-block Elements

Recapitulation of periodic table, special position of hydrogen in the long form of the periodic table, properties of s-block elements w.r.t. electronic configuration, extraction, trends and properties, Introduction to crown ethers and cryptans, separation of s-block elements using crown ethers, Compounds of s-block elements: oxides, hydroxides, peroxides, superoxides.

Application of s-block elements in industrial, biological and agricultural fields.

[Ref. 1,2,3]

### REFERENCES:

1. Concise Inorganic Chemistry-J.D. Lee,Wiley- India 5<sup>th</sup> Edition (Reprint 2009), Chapter8, P 241-242, Chapter-9, P 276-324, Chapter-11, 326-356.
2. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, P.L. Gaus,Wiley- India 3<sup>rd</sup> Edition,(Reprint 2008), P 273-287, 288-307.
3. Concept & model of Inorganic Chemistry-B.E.Douglas D.H. Mc Doniels,Wiley, 3<sup>rd</sup> Edn (1994), p 8-32.

**F. Y. B.Sc. (CBCS-2018 COURSE)**  
**SEMESTER – I**  
**C-13 : PRACTICAL COURSE - I**

**Total Credits: 02**

**Course Learning Outcomes:**

After completion of this course students should be able to:

1. Determine the heat of solution of Potassium nitrate/Ammonium Chloride
2. Find out the relative viscosity of the liquids.
3. Study heat of neutralization and heat of ionization.
4. Perform Qualitative Analysis of Inorganic Mixture containing two basic and two acidic radicals.
5. Preparation of Inorganic compounds

**Course Content:**

**PHYSICAL CHEMISTRY EXPERIMENTS (Any 2)**

1. Instructions in first-aid and safety measures in the laboratory.
2. Determine the heat of solution of the salt, Potassium nitrate/Ammonium Chloride.
3. Determine the relative viscosity of the liquids A and B. hence find by graphical method, the percentage composition of A and B in the given unknown mixture C, using viscosity data.
4. Determination of heat of neutralization and heat of ionization.

**REFERENCES:**

1. Systematic Experimental Physical Chemistry by Rajbhoj and Chondhekar, Anjali Publication. 1<sup>st</sup> Edition, 1990.
2. Experiments in Chemistry by D.V. Jahagirdar, Himalaya Publishing House. Rerpint (2013).

**INORGANIC CHEMISTRY EXPERIMENTS**

**Qualitative Analysis: (Three mixtures)**

**A) Qualitative Analysis of Inorganic Mixture containing two basic and two acidic radicals (other than phosphates & borates)**

**B) Inorganic Preparation (Any One)**

- i) Preparation of tris ethylenediaminenickel (II) thiosulphate  $[\text{Ni}(\text{en})_3]\text{S}_2\text{O}_3$
- ii) Preparation of Tetrammine Copper (II) sulphate monohydrate

**REFERENCES:**

- 1) Inorganic Qualitative Analysis.- by A.I. Vogel, 7<sup>th</sup> Edition, Pearson Education (2002)
- 2) Inorganic Quantitative Analysis. - by A.I. Vogel, 6<sup>th</sup> Edition Prentice Hall; (April 7, 2000)

## ORGANIC CHEMISTRY EXPERIMENTS

### A) Organic preparations: (Any one)

- (i) Aspirin from salicylic acid.
- (ii) Phthalimide from Phthalic anhydride.

### B) Qualitative Analysis: (Any Three)

Detection of type, elements, functional group and M.P. /B.P. of an organic compound.

The 3 compounds analyzed are to be selected from:

- a) Acids: - Benzoic acid, salicylic acid, oxalic acid & Cinnamic acid.
- b) Phenols: - a - Naphthol & b - Naphthol
- c) Bases: - P – Toluidine, Aniline, & m – Nitroaniline.
- d) Neutrals: - m – dinitrobenzene, Acetanilide, Acetone, Nitrobenzene.

### REFERENCES:

- 1) Organic qualitative analysis by A.I. Vogel, (Fourth Edition), Longman group Ltd., England (1996)
- 2) Laboratory Manual of Organic Chemistry by R.K. Bansal, (Second Edition), Wiley Eastern Ltd., New Delhi (1990)

F.Y. B.Sc. (C.B.C.S. 2018 Course)

SEMESTER-I

**B-11: PLANT DIVERSITY AND UTILIZATION OF PLANTS-I  
(ALGAE, FUNGI, BRYOPHYTA & PTERIDOPHYTA)**

Core Course – Theory; Credits- 03

Total lectures- 45 L

**Learning outcomes:**

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

1. Learn about the importance of the plant diversity of cryptogams.
2. Know about the economic importance of algae, fungi, lichen and pteridophytes.
3. Understand evolutionary trends among non-flowering plants.
4. Understand and study detail about various types of algae, fungi, lichen and pteridophytes
5. Conceptualize the role of plants in human welfare with special reference to India.

**Course Content:**

**Algae**

**09L**

**Unit- I** General characters diversity in habitat, forms and classification of algae as per F.E. Fritsch (1935),

**Unit- II** 1 Economic importance and salient features of the following divisions.

- a. Chlorophyta – e.g. *Chlorella*, *Oedogonium*.
  - b. Xanthophyta – e.g. *Vaucheria*
  - c. Phaeophyta – e.g. *Sargassum*
  - d. Rhodophyta – e.g. *Batrachospermum*
  - e. Cyanophyta – e.g. *Nostoc*, *Oscillatoria*
2. Study of life history of *Sargassum*.

**Unit- III** Utilization of algae in the manufacture of industrial products.

**02 L**

**2. Fungi**

**09 L**

**Unit- I** General characters & classification as per Alexopoulos & Mims (1979);

**Unit- II** 1. Economic importance and important features of the following divisions.

- a. Mastigomycotina – e.g. *Albugo*.
  - b. Zygomycotina – e.g. *Mucor*
  - c. Ascomycotina - e.g. *Aspergillus*.
  - d. Basidiomycotina - e.g. *Agaricus*
  - e. Deuteromycetes – e.g. *Cercospora*.
2. Study of life history of *Aspergillus*..

**Unit- III** Utilization of fungi in the manufacture of industrial products.

**02 L**

**3. Lichens** – General account, forms and economic importance.

**02 L**

#### 4. Bryophyte

09 L

**Unit- I** General characters and classification (as per Parihar N.S.)

**Unit- II** 1. Occurrence, thallus structure, reproduction, economics importance of the following divisions.

- a. Hepaticopsida – e.g. *Riccia*.
  - b. Anthocerotopsida – e.g. *Anthoceros*.
  - c. Bryopsida – e.g. *Funaria*
2. Study of life history of *Funaria*.

**Unit- III** Utilization of bryophyta in the manufacture of industrial products.

02 L

#### 5. Pteridophyt

08 L

**Unit- I** Salient features, classification ( as per Parihar N.S.)

**Unit- II** 1. Comparative study of morphology, reproduction and stellar evolution of the following classes.

- a) Psilopsida– e.g. *Psilotum*
- b) Lycopsida – e.g. *Selaginella*
- c) Sphenopsida– e.g. *Equisetum*
- d) Pteropsida– e.g. *Adiantum*

2. Life history of *Selaginella*.

**Unit- III** Utilization of Pteridophyta in the manufacture of industrial products.

02 L

**Note:** Development of sex organs not expected for all above mentioned types.

#### Reference books:

1. Bold, H.C., Alexopoulos, C.J. and Delevoryas, T. 1980. Morphology of plants and fungi ( 4th Edition). Harper and Foul Co., New York.
2. Dube, H.C.1990. An Introduction of fungi. Vikas Publishing House Ltd., Delhi.
3. Gifford, E.M.and Foster, A.S.1989.Morphology and Evolution of Vascular Plants. W.H.Freeman&Co., New York.
4. Gilbert,M.S. 1985. Cryptogamic Botany, Vol.I&II (2nd Edition).Tata McGraw Hill Publishing Co.Ltd., New Delhi.
5. Kumar, H.D.1988. Introductory Phycology.Affiliated East-West Press Ltd., New York.
6. Puri, P.1985. Bryophytes.Atmaram& Sons, Delhi, Lucknow.

7. Parihar, N.S. 1991 Bryophyta. Central Book Depot. Allabad.
8. Parihar, N.S. 1996. Biology & Morphology of pteridophytes. B.I. Publishing pvt.Ltd.
9. E.J. Butler. 2008. The fungi of India. Biotech Book, Delhi.
10. K.S. Bilgrami and R.N. Verma. 2011. Physiology of fungi. Scientific Publisher India.
11. G. Jahir Hussain. 2011. Microbiology fungi and plant pathology. RBSA. Publishers.
12. A.V.S.S. Sambamurthy. Text book of Algae. I.K. International .2006.

**F.Y.B.Sc. (C.B.C.S. 2018 Course)**  
**SEMESTER-I**  
**B-12: CELL BIOLOGY**

**Core Course – Theory; Credits- 03**

**Total lectures- 45 L**

**Learning outcomes**

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

1. Understand the structure of cell organelle in relation to the functional aspects.
2. Understand the difference between prokaryotic and eukaryotic cells.
3. Understand and study detail cell division and cell cycle.
4. Study the details of the plant cell wall, cytosol and cytoplasmic organelles.
5. Understand the properties of nucleic acids (DNA &RNA).

**Course Content:**

- 1. The Cell** **6L**  
Historical background; cell theory; kingdom-wise cell structure; viroids and prions; comparative account of prokaryotic and eukaryotic cell.
- 2. Cell division and its regulation** **10 L**  
Mitosis and meiosis – historical perspective and significance; various stages of cell division progression; cytokinesis; role of centromere, kinetochore and spindle apparatus; animal and plant cell cycle ; mechanisms of cell cycle control; apoptosi
- 3. Nucleus and ribosome** **8 L**  
Ultra structure; nuclear envelope and nuclear pore complex; nuclear matrix and nucleoplasm; DNA and histones; nucleosome and higher level of organization; centromere and telomeres; ribosome structure; prokaryotic, eukaryotic and organelle ribosomes and their functional significance.
- 4. Mitochondrion and chloroplast** **7 L**  
Origin of organelles; organelle structure and biogenesis; organelle membrane and organization of macromolecular complexes; organelle genome organization.
- 5. Structure / function of other sub-cellular structures** **7 L**  
Golgi complex; endoplasmic reticulum ; lysosome; microbodies- peroxisomes and glyoxysomes; cytoskeleton.
- 6. Cell wall and cell membrane** **7 L**  
Origin, ultra structure, chemical constituents and functions of cell wall; models of cell membrane organization; role of various membrane proteins, lipids and carbohydrates; role of ion channels and pumps in cellular transport and signaling.



**Reference books:**

1. Alberts, B., Bray, Lewis, J., Raff, M., Roberts, K. and Watson, J.D. 1999. Molecular Biology of Cell. Garland Publishing Co., Inc., New York, USA.
2. Avers, C.J. 1986. Molecular Cell Biology. Addison- Wesley Publishing, Massachusetts, USA.
3. Campbell, M.K. 1999. Biochemistry (3rd Edition). Saunders College Publishing, Philadelphia, USA.
4. Gupta, P.K. 1999. A Text –book of Cell and Molecular Biology. Rastogi Publications, Meerut, India.
5. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2nd Edition). Harper Collins College Publishers, New York, USA.
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2000. Molecular Cell Biology (4th Edition). W.H. Freeman and Co., New York, USA.
7. Nelson, D.L. and Cox, M.M. 2000. Lehninger Principles of Biochemistry (3rd Edition). Worth Publishers, New York, USA.
8. Rawn, D.J. 1989. Biochemistry. Neil Patterson Publishers, North Carolina, USA.
9. Stryer, L. 1995. Biochemistry. W.H. Freeman and Co., New York, USA.

**F.Y.B.Sc. (BOTANY) (C.B.C.S. 2018 Course)**  
**B-I: PRACTICAL COURSE-I**  
**(PLANT DIVERSITY AND UTILIZATION OF PLANTS-I AND II)**  
**Core Course – Theory; Credits- 02**

**Learning Outcome :**

1. Study of algal diversity w.r.t Systematic position and morphology.
2. Study of Life cycle of *Spirogyra* and *Sargassum*.
3. Students will learn to identify the plants with their systematic position
4. Know botanical source/s, characteristics and utilities of Plants/ plant products.
5. Training students to prepare micropreparation and showing the stages of mitosis (Onion root tips) and showing permanent slides/photographs of mitosis and meiosis .
6. Know the Economic Importance of Fungi.
7. Understand the features of Lichens.
8. Understand the habit of the angiosperm plant body. Know the vegetative characteristics of the plant. Learn about the reproductive characteristics of the plant. Understand the plant morphology.

**Course Content:**

1. Study of Algae with the help of permanent slides / material of the following types. 1P(D)  
e.g. *Chlorella*, *Vaucheria*  
e.g. *Volvox*, *Hydrodictyon*, *Batrachospermum*
2. Study of Life history of Sargassum 1P
3. Study of Fungi with the help of permanent slides /material of of the following types. 1P D)  
  
e.g. *Mucor* Yeast, *Albugo*, *Penicillium*, *Aspergillus*, *Puccinia*, *Agaricus* .
4. Study of life history of *Cystopus* 1 P
5. Study of Lichens - forms with suitable examples, *Usnea* – apothecium - T.S. 1 P
6. Study of Bryophyta - morphology, reproductive structures in of the following types. 1P D  
e.g. *Marchantia*, *Anthoceros* and *Funaria*.
7. Study of life history of *Funaria*. 1 P
8. To demonstrate production of algal biomass (SCP) by culturing *Spirulina* at Laboratory level 1 P
9. Study of movement of protoplasm in *Hydrilla* and *Tradescantia* 1 P
10. Study of various stages of mitosis and meiosis using root tips and flower buds of onion. 2P
11. Demonstration: Use of yeast in bakery industry. 1 P

**ANGIOSPERMS**

12-16. A Study of representative members of the following families

- |                   |     |
|-------------------|-----|
| i) Brassicaceae   | 1 P |
| ii) Papilionaceae | 1P  |
| iii) Malvaceae    | 1P  |
| iv) Rubiaceae     | 1 P |
| v) Liliaceae      | 1 P |

**F. Y. B.Sc. (CBCS - 2018 Course)**

**SEMESTER I**

**Z 11: Animal systematic and Functional Anatomy of Non-chordates - I**

**Total Credit: 03**

**Total lectures: 45**

**Course Outcomes:**

On completion of the course, students are able to:

1. Love and understand the fascinating world of invertebrates.
2. Understand and study the animal kingdom and principles of classification of animals, Binomial Nomenclature and five kingdom approach.
3. Understand and study of *Paramecium* w.r.to systematic position, morphology, nutrition and reproduction.
4. Understand systematic position external morphology of non-chordate animals like cockroach and earthworm.
5. Understand the various internal systems like digestive system, nervous system, reproductive system and sense organ -eye of cockroach with the help of charts, models.
6. Understand the various internal systems like digestive system, nervous system, reproductive system of earthworm with the help of charts, models.

**Course Content**

**UNIT I**

**1. Principals of classification**

- i) Importance of classification
- ii) Binomial nomenclature
- iii) Five kingdom approach

**2. Study of *Paramecium***

- i) Systematic position, habits and habitat
- ii) General morphology
- iii) Nutrition
- iv) Reproduction (Binary fission and conjugation)

**UNIT II**

**3. Study of *Earthworm***

- i) Systematic position and external morphology
- ii) Digestive system
- iii) Circulatory system
- iv) Excretory system
- v) Nervous system
- vi) Reproductive system

**UNIT III**

**4. Study of Cockroach**

- i) Systematic position and external characters
- ii) Digestive system
- iii) Respiratory system -Thorasic spiracle and Abdominal spiracle structure and function
- v) Excretory system - Malpighian tubules and physiology of excretion
- vi) Nervous system - Central nervous system and Photoreceptor organ
- vii) Reproductive system - Sexual dimorphism, male and female reproductive system.

## Reference Books

1. Text book of zoology Invertebrates Vol.1 (1992) - Parker andHaswell.
2. Invertebrate Zoology (1983) - E.L.Jordan and P.S.Verma
3. Modern text book of Zoology – Invertebrate - Kotpal, Agarwal and Khetarpal.
4. Invertebrate structure and function - Barrington.
5. College Zoology - Boolootin and stiles.
6. A manual of Zoology, part-I: Invertebrate - EkambernathIyer.
7. Text book of Zoology Invertebrates - Marshall and Williams.
8. Biology of Non-chordates - Nigam.
9. A life of invertebrate - Russel Hunter.
10. Zoology, Non-chordates - Marathe, Agarkar and Joshi
12. Protozoa. Mollusca and Arthropoda.- R.L. Kotpal
13. InvertebrateZoology- Barnes.
14. A manual of practical Zoology Invertebrates - P.S.Verma.

**F. Y. B.Sc. (CBCS - 2018 Course)**  
**SEMESTER I**

**Z 12 :Cell Biology and Genetics**

**TotalCredits- 03**

**Total lectures : 45**

**Course Outcomes:**

On completion of the course, students are able to:

1. Understand the scope of cell biology because cell is the basic unit of life.
2. Understand the main distinguishing characters of plant cell and animal cell.
3. Able to differentiate between prokaryotes and eukaryotes.
4. Study and understand the cell organelles with their structure and function.
5. Explain Mendelism expanding Mendel's Laws.
6. Understand the basic concepts of Mendelian genetics, its variations and applications.
7. Study and understand structure of chromosome, chromosomal abnormalities.
8. Gain knowledge about applications of genetics.

**Course Content**

**UNIT I - Cell Biology**

**1. Introduction to cell Biology**

- i. Definition and scope
- ii. General cell structure – Prokaryotic and Eukaryotic cell

**2. Ultrastructure and Functions of**

- i. Nucleus
- ii. Plasma membrane ( Fluid Mosaic model)
- iii. Mitochondria
- iv. Lysosomes
- v. Ribosomes
- vi. Golgi complex
- vii. Endoplasmic reticulum
- viii. Cytoskeleton – Microtubules & Microfilaments

**UNIT II - Genetics**

**3. Introduction to genetics**

- i. Mendelian inheritance
  - a) Monohybrid cross
  - b) Dihybrid cross
- ii. Multiple Alleles
  - a) ABO blood group system and its importance
- iii. Incomplete dominance, Co-dominance

#### **4. Chromosomes**

- i. Morphology and composition
- ii. Classification
- iii. Types ( Autosomes and sex chromosomes)
- iv. Aberrations – numerical and structural changes

#### **5. Introduction to Human genetics**

- i. Syndromes
  - a) Autosomal – Down's (Mangolism), Cri-du-chat.
  - b) Sex chromosomal abnormalities in man – Klinefelter and Turner's syndrome

#### **6. Application of genetics**

- i. Genetic counselling
- ii. Eugenics

#### **Reference books :**

1. Cell and Molecular Biology By De Robertis, EDP. And De Robertis EME, Molt Saunders Inc.
2. Cell Biology By Pawar, CB, Himalaya Publication House
3. Cell and Molecular Biology By Dupraw I, Academic Press, New York
4. Cell Biology By Avers, CJ., Addison Wesley Pub. Co. New York and London
5. Genetics By Verma, PS. And Agarwal VK., S. Chand and Co., New Delhi
6. Genetics By Gupta PK., Rastogi Publication, Meerut
7. Genetics By Sarin, C., Tata McGraw Hill, New Dehi
8. Cell Biology, Genetics, Evolution and Ecology By Verma, PS. And Agarwal S. Chand and Co., New Delhi

**F. Y. B.Sc. (CBCS - 2018 Course)**  
**SEMESTER I**  
**Z 13 : Zoology Practical course –I**  
(Practical based on paper: Z-11, Z-12)

**Total Credits: 02**

**Contact hours per practical – 04 h**

**Course Outcomes:**

On completion of the course, students are able to:

1. Study and understand the classification of whole phyla from protozoa to Annelida with the help of charts/ models/ pictures.
2. Study of *Paramecium* with the help of slides.
3. Understand the various internal systems like digestive system, nervous system, reproductive system, respiratory organs of cockroach with the help of charts.
4. Understand the various internal systems like digestive system, nervous system, reproductive system, respiratory organs of earthworm with the help of chats.
5. Study and understand prokaryotes and eukaryotes with the help of photographs.
6. Study and understand the animal cell with the help of photograph.
7. Study and understand various cell organelles by using microphotographs.
8. Understand genetics through genetic examples based on monohybrid ratio, dihybrid ratio and multiple alleles.
9. Study of characters of syndromes.

**Course Content**

1. Study of general and distinguishing characters and classification of non-chordates upto class level with one example of each class. **D**
  - a. Protozoa
  - b. Porifera
  - c. Coelentrata
  - d. Platyhelminthes
  - e. Aschelminthes
  - f. Annelida
2. Study of systematic position, external features, binary fission and conjugation of *paramecium*. **D**
3. Study of external characters and Digestive system of Earthworm. **E**
4. Study of Nervous system of Earthworm. **E**
5. Mounting of Earthworm- Septal nephridium, setae and spermatheca. **E**
6. Study of systematic position, external characters and digestive system of Cockroach. **E**
7. Study of Nervous system of Cockroach. **E**
8. Mounting of Cockroach - Gizzard, salivary glands, mouthparts, Trachea, spiracles. **E**
9. Study of prokaryotic and eukaryotic cell with the help of suitable material. **D**
10. Study of any 3- cell organelles with the help of suitable material. **D**

11. Examples in Genetics: **E**  
Examples based on Monohybrid cross, Dihybrid cross & Multiple alleles (At least 10 examples must be solved).
12. Study of characters of syndromes – Down’s, Klinefelter’s & Turner’s Syndrome. **E**

**Study Tour:**

Compulsory visit to large water body / Biodiversity spot / ZSI / Any project

Students be introduced to learning dissections / anatomy adapting CDS / Web sources.

\***E** – Experiments

\***D** – Demonstration Practical

**Reference books:**

1. A manual of practical zoology Invertebrates : P. S. Verma
2. A manual of practical zoology Non Chordata Vol. 1 : P. K. G. Nair and K. P. Achar
3. Practical Zoology, Invertebrates : S.S. Lal
4. Practical Invertebrates Zoology : Agarwal.
5. Kotpal, R.L., (All Series) Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca & Echinodermata : Rastogi Publications
6. Cell and Molecular Biology De Robertis, E.D.P. and E.M.F. De Robertis 1987
7. Genetics: Verma, P.S. and V.K. Agarwal. 1997. S.Chand & Co.
8. Genetics : Gupta P.K. 1995-96, Rastogipublicati



**F. Y. B. Sc. (CBCS – 2018 course)**

**Semester I**

**MB – 11: Introduction to Microbiology**

**Total credits: 03**

**Total Lectures: 45**

**Learning outcomes:**

**At the end of this course the students will be able to:**

1. Understand the scope of the Microbiology subject.
2. Use the Microscopes for observing different life forms including Bacteria, Fungi, Protozoa and Algae
3. Understand principles of chemistry to be used for exploring biological interactions among microorganisms.

**Course Content:**

**(I) The Development of Microbiology and its Scope**

**08**

- Microbes in our lives
- The scope and Relevance of Microbiology, Microbes and Human Welfare: Aerobiology, Recycling of Vital Elements  
Sewage treatment: Using Microbes to Recycle water  
Bioremediation: Using microbes to clean up Pollutants.  
Insect/ pest control by microorganisms.  
Modern Biotechnology and Genetic Engineering: Basic concepts
- A Brief History of Microbiology  
The first observations – Antony van Leeuwenhoek  
Theories of spontaneous generation.  
The golden age of Microbiology – Louis Pasteur; Pasteur and disease, Robert Koch and pure culture Techniques  
Development of Microbiology in 19<sup>th</sup>, 20<sup>th</sup> and 21<sup>st</sup> century:  
Ten important/Noble prize winning contributions from each century.
- Microbes and Human Diseases, Normal Micro biota  
Infectious Diseases, The birth of Modern chemotherapy Emerging Infectious Diseases.
- Modern Developments in Microbiology
- The future of Microbiology.

**(II) Principles of Chemistry**

**12**

- How atoms form Molecules: Chemical bonds.
- Types of bonds: Ionic Bonds, Covalent bonds, Hydrogen bonds., Molecular Weight & Moles
- Chemical Reactions

Energy in Chemical reactions

Types of chemical reactions: Synthesis, Decomposition, Exchange and Reversible reactions.

Inorganic compounds – Water, Acids, Bases and Salts. Acid-Base Balance

- Major organic compounds of living things – Structure & Function of Carbohydrates, Lipids, Proteins, Nucleic acids, Adenosine Triphosphate (ATP).

(III)

Microscopy

25

- Units of Measurement
- Lenses and the Bending of Light
- Light Microscopy: parts and their functions ( Principle working and applications)
- Dark field and phase contrast microscopy functions (Principle working and applications)
- Fluorescence and Electron Microscopy, TEM & SEM (Principle working and applications)
- Preparation of Specimens for light microscopy  
Preparing smears for staining  
Simple Staining - Monochrome, Negative  
Differential staining – Gram’s staining and Acid Fast staining  
Special Staining – Spore, Capsule, Cell wall, Flagella, Lipid granules, Metachromatic granules.

#### References:

1. Alcamo, Edward. I. (2007). Fundamentals of Microbiology, Eighth Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts. (Chapter No.1,2,3.)
2. Dubey R.C., D. K. Maheshwari, Second Ed.(2010)  
A Textbook of Microbiology, S. Chand And Company
3. Ingraham. J. L and C. A. Ingraham (2000) Introduction to Microbiology .Second Edition Thompson Learning Inc. (Chapter No2,3.)
4. Hofkin Bruce V.(2011) Living in a Microbial World. Garland Science. . (Chapter No1,2,5,15,16)
5. Madigan , M.T. and J.M. Martinko (2006), Brock. Biology of Microorganisms 11<sup>th</sup> Edition, International Edition. Pearson , Prentice Hall. (Chapter No.4.)
6. Manoharachary K. and B.R. Tilak(2012),  
Principles of Microbiology, I. K. International Publishing House Pvt. Ltd
7. Pelczar M. J., Chan E.C.S., Krieg N.R. (2010),  
Microbiology, 39<sup>th</sup> Edition , Tata McGraw-Hill
8. Powar Daginwala Tenth Ed.(2010)  
General Microbiology Vol.2, Himalaya Publishing House
9. Prescott, Lancing. M., John, P. Harley and Donald, A. Klein (2008) Microbiology, Eighth Edition McGraw Hill Higher Education. (Chapter No.,2.)
10. Tortora, Gerard. J., Berdell, R. Funk and Case, Christine L. (2007) Microbiology: an Introduction, Ninth Edition, Pearson Education. (Chapter No. 3,5.)

**F.Y.B.Sc. (CBCS – 2018 course)**  
**Semester I**  
**MB – 12: Structure of Prokaryotes and Eukaryotes**

**Total credits: 03**

**Total Lectures: 45**

**Learning Outcomes:**

1. Learn intracytoplasmic organelles of Microorganisms and their significance
2. Understand the significance of different groups of microorganisms
3. Know the structure, properties and significance of viruses
4. Understand the useful and harmful activities of microorganisms in soil, water and air
5. Know the futuristic therapeutic tools like ESKAPE therapy to overcome drug resistant pathogens
6. Understand the ethical and unethical use of microorganisms in the form of 'Bioterrorism'
7. Develop practical skills for observation and cultivation of microorganisms.

**Course Content:**

<b>(I)</b>	Prokaryotic Cell Anatomy	10
	<ul style="list-style-type: none"><li>• Size, shape and arrangement of bacterial cells.</li><li>• Structure of typical bacterial cell.</li><li>• Structure and functions of cell wall.</li><li>• Composition and functions of 'Bacterial capsule'.</li><li>• Fluid Mosaic Model of bacterial cell membrane.</li><li>• Structure and functions of Flagellum</li><li>• Arrangements of Flagella</li><li>• Pili</li></ul>	
<b>(II)</b>	Structure & functions of cell organelles	10
	<ul style="list-style-type: none"><li>• Ribosome</li><li>• Metachromatic granules</li><li>• Poly <math>\beta</math> hydroxybutyrate (PHB) granules.</li><li>• Carboxysomes</li><li>• Gas vacuoles</li><li>• Endospore</li></ul>	

- (III) General properties and significance of following groups of microorganisms. 10
- *Rickettsias*
  - *Chlamydia*
  - *Coxiella*
  - *Mycoplasma*
  - *Archaeobacteria*
  - *Actinomycetes*
  - Algae
  - Fungi
  - Protozoa
- (IV) The Viruses 15
- Introduction and General characteristics,
  - Morphological types of viral capsids
    - Icosahedral, Helical, Complex
  - Types of viral nucleic acids with representative examples.
  - Virus cultivation using ‘Embryonated Egg’
  - Virus cultivation using ‘Tissue Culture Technique’  
Merits and demerits of the following-
    - Primary cell cultures
    - Diploid cell cultures
    - Continuous cell cultures
  - Structure of ‘T4 Bacteriophage’.
  - Viroids and Prions.

References:

- 1 Alcamo, Edward. I. (2001) .Fundamentals of Microbiology, Sixth Edition, Jones and Bartlett Publishers, Sudbury, Massachusetts.(Topic No-1 and2).
2. Prescott, Lansing. M., John, P. Harley and Donald, A. Klein (2006) Microbiology, Sixth Edition McGraw Hill Higher Education.(Topic No 1 , 2 ,4)
3. Tortora, Gerard. J., Berdell, R. Funk and Case, Christine L. (2004). Microbiology: an Introduction, Eight Edition, Pearson Education.(Topic No 1 and 2).
4. Madigan , M.T. and J.M. Martinko (2006), Broch Biology of Microorganisms 11<sup>th</sup> Edition, International Edition. Pearson , Prentice Hall (Topic No. 1 and3)
5. Pelczar M. J.,Chan E.C.S., Krieg N.R. (2010), Microbiology, 39<sup>th</sup> Edition, Tata McGraw-Hill.( Topic No. 3,4).
6. Manoharachary K. and B. R.,Tilak (2012), Principles of microbiology, I. K. International Publishing House Pvt. Ltd.( TopicNo.3).

**F. Y. B. Sc. (CBCS – 2018 course)**  
**Semester I**

**Practical Course: MB-13 (Based on MB 11 and MB 12)**

**Learning Outcomes:**

After completion of the paper, students will be able to,

1. Observe bacteria and other life forms under 100x objectives
2. Observe motility bacteria
3. Cultivate the bacteria
4. Observe the bacteria or a part of bacteria using appropriate staining procedure.

**Course Contents:**

- 1) Laboratory safety: General rules and regulations.
- 2) Study of laboratory equipment.
  - i) Incubator,
  - ii) Autoclave,
  - iii) Laminar Air Flow
  - iv) Oven
  - v) Colony counter
  - vi) Water bath,
  - vii) pH-Meter
- 3) Use care and study of Compound Microscope
  - i) Parts of microscope and their functions.
  - ii) Taking care of Microscope
  - iii) Using a Microscope.
- 4) Aseptic transfer techniques and demonstration of Inoculation techniques
  - i) Broth inoculation
  - ii) Plate inoculation
  - iii) Slant inoculation
  - iv) Butt inoculation
- 5) Staining Techniques.
  - a) Basic Staining Techniques
    - i) Monochrome Staining
    - ii) Negative staining
    - iii) Gram staining
  - b) Special Staining Techniques
    - i) Cell wall staining
    - ii) Endospore staining
    - iii) Capsule Staining
    - iv) Flagella Staining
    - v) Staining of 'Metachromatic Granules'
    - vi) Staining of 'Lipid Granules'

## References

1. Bradshaw L. Jack (1979) Laboratory Microbiology, Third Edition W.B. Saunders co Philadelphia, London ,Toronto.
2. Benson H.J. ( 1990) Microbiological Applications A Laboratory Manual in General Microbiology, Fifth Edition Wm.C Brown Publisher.
3. Cappuccino J.G. and N. Sherma ( 2004 ) Microbiology A Laboratory Manual Sixth Edition, Pearson Education
4. Cruickshank R and J.P. Duguid (1980 ) Medical Microbiology Volume II, 12<sup>th</sup> Edition. The Practice of Medical Microbiology , Churchill Livingstone Edinburgh, London and New York.
5. Pelzar M.J. and E.C.Schan( 1972) laboratory Exercise in Microbiology Third Edition ( Practical Manual Tata Macgraw Hill Edition New Delhi.
6. Sharma K. ( 2005 ) Manual of Microbiology Tools & Techniques Ane Books New Delhi.

**F. Y. B. Sc. (CBCS 2018 Course)**  
**Semester-I**  
**M-11: Algebra**

**Total Credit: 03**

**Total Lectures: 45**

**Course Learning Outcomes:**

At the end of this course students are expected to be able to

1. Find the rank of matrix by conversion of matrix into echelon form.
2. Solve the system of Linear equations.
3. Division algorithm and obtain g.c.d. by division algorithm.
4. Solution of the equations by De Moivre's theorem and  $n^{\text{th}}$  root of unity.

**Course content:**

**Unit 01: Matrices and System of Linear Equations.**

- 1.1 Revision, adjoint of a square matrix and inverse of square matrix by adjoint method.
- 1.2 Echelon and reduced echelon form of a matrix, Reduction of a matrix to its echelon form. Rank of a matrix by using echelon form. Rank of a matrix by reducing the matrix into normal form.
- 1.3 System of homogeneous Linear equations in matrix form and its general solution.
- 1.4 System of non-homogeneous Linear equations in matrix form. Consistency of system of non-homogeneous linear equations and the solution of the system. Gauss Elimination method.
- 1.5 Eigen Values, characteristic equation of matrix of order up to  $3 \times 3$ .
- 1.6 Statement of Cayley Hamilton theorem and its use to find the inverse of a matrix.

**Unit 02: Integers.**

- 2.1 Well ordering principle for  $\mathbb{N}$ . Principle of mathematical induction.
- 2.2 Divisibility in  $\mathbb{Z}$ : Definition and elementary properties. Division algorithm, Euclidean algorithm (without proof).
- 2.3 G.C.D. and L.C.M. of integers. Relatively prime integers, Euclid's lemma; Basic properties of G.C.D., G.C.D. of any two integers  $a$  and  $b$  if they exist are unique and can be expressed in the form  $ax + by$  where  $x, y \in \mathbb{Z}$
- 2.4 Equivalence relations, Equivalence classes, Properties of equivalence Classes. Definition of partition, every partition gives an equivalence relation. Definition of congruence; congruence as equivalence relation in  $\mathbb{Z}$ .

**Unit 03: Complex Numbers.**

- 3.1 Complex numbers, Algebra of complex numbers, conjugate complex number, properties of conjugate complex numbers. Sum and product of complex number and its conjugate is real.
- 3.2 Modulus amplitude form of a complex number properties of modulus and amplitude.
- 3.3 De Moivre's theorem.
- 3.4  $n^{\text{th}}$  roots of unity.
- 3.5 Solution of the equations by using De Moivre's theorem.

### Reference Books:-

- 1 K. B.Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi – 2000
- 2 P.B. Bhattacharya,S. K. Jain, S. R. Nagpal, First course in Linear Algebra, Wiley Eastern, New Delhi, 1983
- 3 Shanti Narayan: A text Book of Matrices.
- 4 S. K. Jain, A Gunawardena and P.B. Bhattacharya: Basic Linear Algebra with MATLAB, Key College publishing (Springer - Verlag), 2001.
- 5 Patil, Bhamere, Bhagat, Waingade, Phatangre, Masalkar,: Algebra & Geometry; Nirali Prakashan



**F. Y. B. Sc. (CBCS 2018 Course)**  
**Semester-I**  
**M-12: Calculus**

**Total Credit: 03**

**Total Lectures: 45**

**Course Learning Outcomes:**

At the end of this course students are expected to be able to

1. Discuss the continuity of the functions at a point and interval.
2. Verify mean value theorems.
3. Obtain Taylor's and Maclaurin's expansions of functions.
4. Discuss the convergence of sequences and series.

**Course content:**

**Unit 1: Limit and Continuity:**

- 1.1  $\epsilon$ -  $\delta$  definition of the limit of a function.
- 1.2 Basic properties and some theorems of limits.
- 1.3 Continuity of a function at a point. Types of discontinuity.
- 1.4 Continuous function on an interval.
- 1.5 Properties of continuous function on closed and bounded intervals  
(a) Boundedness (b) Attains its bounds (c) Intermediate value theorem

**Unit 2: Differentiability:**

- 2.1 The derivative of a function. Property between continuity and differentiability.
- 2.2 Mean value theorem: (a) Rolle's mean value theorem (b) Lagrange's mean value theorem (c) Cauchy's mean value theorem
- 2.3 Geometrical interpretations of mean value theorems.
- 2.4 Indeterminate forms L' Hospital's rule.
- 2.5 Higher order derivatives,  $n^{\text{th}}$  derivatives of some standard functions, Leibnitz's theorem.

**Unit 3: Sequences and Series:**

- 3.1 Convergent and divergent sequences, Algebra of convergent sequences.
- 3.2 Bounded sequence, monotonic sequences and convergence of sequences.
- 3.3 Convergence of  $\{ a_n \}$  where  $a_n = \left(1 + \frac{1}{n}\right)^n$
- 3.4 Taylor's and Maclaurin's theorem with Lagrange's form of remainder (without proof)
- 3.5 Convergence of  $\sum_{n=1}^{\infty} \frac{1}{n^p}$
- 3.6 Convergence of simple series by using comparison test and Ratio test.

**Reference Books:-**

1. P. K. Jain and S. K. Kaushik, An Introduction to Real Analysis, S. Chand and Co., New Delhi.
2. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd., Alahabad
3. T. M. Apostol, calculus Vol. I and Vol. II, Wiley International Edition.
4. Shanti Narayan: Differential Calculus.
5. R. G. Bartle, Dr. R. G. Sherbert; Introduction to Real Analysis, John Wiley and sons.
6. Patil, Bhamere, Bhagat, Waingade, Phatangre, Masalkar: Calculus and Differential Equations; Nirali Prakashan

**F. Y. B. Sc. (CBCS 2018 Course)**  
**Semester-I**  
**M-13: Mathematics Practical Course –I**  
**(Practicals based on the applications and Problems of articles in M-11 and M-12)**

**Total Credit :02**

**Course Learning Outcomes :**

After completion of this course students will acquire:

- i. Knowledge of solving problems of Matrices, Systems of linear equations.
- ii. Knowledge of solving problems of Limit and Continuity.
- iii. Knowledge of solving problems of Derivatives and applications of mean value theorem.
- iv. Solve Problems on finding Eigen values and Eigen vectors.

**Course content**

**List of Practicals:**

1. Rank of matrix
2. Solution of system of Linear equations
3. Limit and Continuity
4. Integers
5. Equivalence relation, equivalence classes and partition, congruence relation.
6. Differentiation.
7. Complex numbers (De Moivre's theorem and  $n^{\text{th}}$  roots of unity)
8. Leibnitz's theorem
9. Convergence of Sequences and series
10. Eigen values and inverse of a matrix by Cayley Hamilton theorem

**F. Y. B. Sc.: (CBCS 2018 Course)**  
**Semester-I**  
**S-11: Descriptive Statistics– I**

**Total Credit: 03**

**Total Lectures: 45**

**Course Learning Outcomes:**

After completion of this course students will acquire:

- i. Importance and scope of statistics in various fields such as medical, management, economics, social science etc.
- ii. Information about statistical organization in India and state and their functions in social development.
- iii. Knowledge of different types of data and its classification
- iv. Knowledge of organisation and evaluation of different types of data and evaluation of summary measure such as measures of central tendency, dispersion, skewness and kurtosis
- v. Knowledge of qualitative data including concept of association of two attributes

**Course content:**

**Unit 1. Introduction to Statistics**

- 1.1 Meaning of Statistics as a Science.
- 1.2 Importance of Statistics.
- 1.3 Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social Sciences, Management sciences, Agriculture, Insurance, Information technology, Education and Psychology.
- 1.4 Statistical organizations in India and their functions:

**Unit 2. Types of Data and Population and Sample**

- 2.1 Types of characteristics:  
Attributes: Nominal scale, ordinal scale,  
Variables: Interval scale, ratio scale, discrete and continuous variables, difference between linear scale and circular scale
- 2.2 Types of data:  
(a) Primary data, Secondary data  
(b) Cross-sectional data, time series data, directional data.
- 2.3 Notion of a statistical population: Finite population, infinite population, homogeneous population and heterogeneous population. Notion of a sample and a random sample
- 2.4 Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRSWOR) stratified random sampling, systematic sampling, cluster sampling and two-stage sampling.

### **Unit 3. Basic Statistics:**

Review / Revision of Presentation of Data

3.1 Classification: Raw data and its classification, ungrouped frequency distribution, Sturges' rule, grouped frequency distribution, cumulative frequency distribution, inclusive and exclusive methods of classification, Open end classes, and relative frequency distribution.

3.2 Measures of Central Tendency

Review / Revision of following topics: Concept of central tendency of statistical data, Statistical averages, characteristics of a good statistical average. Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmetic mean. Mode and Median: Definition, formulae (for ungrouped and grouped data), merits and demerits. Empirical relation between mean, median and mode (without proof). Topics to be taught in detail: Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box Plot. Geometric Mean (G.M.): Definition, formula, merits and demerits. Harmonic Mean (H.M.): Definition. Formula, merits and demerits. Order relation between arithmetic mean, geometric mean, harmonic mean. Weighted Mean: weighted A.M., G.M. and H.M. Situations where one kind of average is preferable to others.

3.3 Measures of Dispersion

Review / Revision of following topics: Concept of dispersion, characteristics of good measure of dispersion. Range, Semi-interquartile range (Quartile deviation): Definition, merits and demerits, Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, combined variance for  $n$  groups (derivation for two groups).

Topics to be taught in detail: Mean squared deviation: Definition, minimality property of mean squared deviation (with proof), Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (C.V.)

3.4 Examples

### **Unit 4. Moments, Skewness and Kurtosis**

4.1 Raw moments ( $m'_r$ ) for ungrouped and grouped data.

4.2 Central moments ( $m_r$ ) for ungrouped and grouped data, Effect of change of origin and scale.

4.3 Relations between central moments and raw moments, upto 4-th order (without proof).

4.4 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution.

4.5 Bowley's coefficient of skewness :Bowley's coefficient of skewness lies between  $-1$  to  $1$  ( with proof ), interpretation using Box plot.

4.6 Karl Pearson's coefficient of skewness.

4.7 Measures of skewness based on moments ( $\beta_1, \gamma_1$ ).

4.8 Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions.

4.9 Measures of kurtosis based on moments ( $\beta_2, \gamma_2$ ).

4.10 Examples

## **Unit 5. Theory of Attributes**

- 5.1 Attributes: Concept of a Likert scale, classification, notion of manifold classification, dichotomy, class- frequency, order of a class, positive class frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes), and dot operator to find the relation between frequencies, fundamental set of class frequencies.
- 5.2 Consistency of data upto 2 attributes.
- 5.3 Concepts of independence and association of two attributes.
- 5.4 Yule's coefficient of association (Q),  $-1 \leq Q \leq 1$ , interpretation.
- 5.5 Examples

### **Recommended Books:**

1. Agarwal, B. L. (2003). Programmed Statistics, Second Edition, New Age International Publishers, New Delhi.
2. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis Third Edition, John Wiley and Sons
3. Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, The World Press Pvt. Ltd., Calcutta.
4. Gupta, S. C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
5. Gupta, S. C. and Kapoor, V. K. (1997). Fundamentals of Applied Statistics, Third Edition, Sultan Chand and Sons Publishers, New Delhi.
6. Purohit, S. G., Gore S. D., Deshmukh S. R. (2008). Statistics Using R, Narosa Publishing House, New Delhi.
7. Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC. Prentice Hall of India, New Delhi.
8. Snedecor G. W. and Cochran W. G. (1989). Statistical Methods, Eighth Ed. East- West Press.
9. Hanagal David D. (2009). Introduction to Applied Statistics: A non-calculus based approach. Narorse Publishing House. New Delhi

S- 12: Discrete Probability and Probability Distributions –I

Total Credit: 03

Total Lectures: 45

**Course Learning Outcomes:**

After completion of this course students will acquire:

- i. Ability to distinguish between deterministic and non-deterministic experiments.
- ii. Knowledge related to different types of events.
- iii. Knowledge of probability of events including axiomatic approach, simultaneously they are learning conditional probability including Baye's theorem.
- iv. Knowledge related to concept of discrete random variable and their probability distributions including expectations and moments.
- v. Knowledge of important discrete distributions such as uniform distribution, Binomial distribution, hypergeometric distribution and acumen to apply standard discrete distributions to different situations.

**Course content:**

**Unit 1. Basic Concept of probability, conditional probability, independence and Bayes' Theorem**

- 1.1 Experiments/Models, Ideas of deterministic and non-deterministic models. Random Experiment, concept of statistical regularity.
- 1.2 Definitions of - (i) Sample space, (ii) Discrete sample space: finite and countably infinite, (iii) Event, (iv) Elementary event, (v) Complement of an event. (vi) Certain event (vii) Impossible event
- 1.3 Concept of occurrence of an event.
- 1.4 Algebra of events and its representation in set theory notation. Occurrence of following events.
  - (i) at least one of the given events,
  - (ii) none of the given events,
  - (iii) all of the given events,
  - (iv) mutually exclusive events,
  - (v) mutually exhaustive events,
  - (vi) exactly one event out of the given events.
- 1.5 Classical definition of probability and its limitations.
- 1.6 Probability model, probability of an event, equiprobable and non-equiprobable sample space,
- 1.7 Axiomatic definition of probability.
- 1.8 Definition of conditional probability of an event.
- 1.9 Definition of independence of two events  $P(A \cap B) = P(A) \cdot P(B)$
- 1.10 Pairwise independence and mutual independence for three events
- 1.11 Multiplication theorem  $P(A \cap B) = P(A) \cdot P(B|A)$ . Generalization to  $P(A \cap B \cap C)$ .
- 1.12 Partition of the sample space
- 1.13 Proof of Bayes' theorem. Applications of Bayes' theorem in real life
- 1.14 Examples

## Unit 2. Univariate Probability Distributions

- 2.1 Concept and definition of a discrete random variable.
- 2.2 Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.),  $F(\cdot)$  of discrete random variable, properties of c.d.f..
- 2.3 Mode and median of a univariate discrete probability distribution.
- 2.4 Examples

## Unit 3. Mathematical Expectation (Univariate Random Variable)

- 3.1 Definition of expectation (Mean) of a random variable, expectation of a function of a random variable, m.g.f. and c.g.f. Properties of m.g.f and c.g.f.
- 3.2 Definitions of variance, standard deviation ( s.d.) and Coefficient of variation (c.v.) of univariate probability distribution, effect of change of origin and scale on mean, variance and s.d.
- 3.3 Definition of raw, central and factorial raw moments of univariate probability Distributions and their interrelations (without proof).
- 3.4 Coefficients of skewness and kurtosis based on moments.
- 3.5 Examples

## Unit 4. Some Standard Discrete Probability Distributions - I

- 4.1 Degenerate distribution (one point distribution),  $P(X=c) = 1$ , mean and variance.
- 4.2 Uniform discrete distribution on integers 1 to n: p.m.f., c.d.f., mean, variance, real life situations, comments on mode and median.
- 4.3 Bernoulli Distribution: p.m.f., mean, variance.
- 4.4 Binomial Distribution: p.m.f.

$$p(x) = \binom{n}{x} p^x q^{n-x}; x = 0, 1, 2, 3, \dots, n, 0 < p < 1, q = 1 - p$$
$$= 0 \text{ otherwise}$$

Notation :  $X \sim B(n, p)$ .

Recurrence relation for successive probabilities, computation of probabilities of different events, mode of the distribution, mean, variance, m.g.f. and c.g.f. moments, skewness (comments when  $p = 0.5$ ,  $p > 0.5$ ,  $p < 0.5$ ). Situations where this distribution is applicable.

- 4.5 Hypergeometric Distribution : p.m.f.,

$$p(x) = \frac{\binom{M}{x} \binom{N-M}{n-x}}{\binom{N}{n}} x = 0, 1, \dots, \min \{M, n\},$$
$$= 0 \text{ otherwise}$$

Notation :  $X \sim H(N, M, n)$ .

Computation of probability, situations where this distribution is applicable, binomial approximation to hypergeometric probabilities, mean and variance of the distribution.

- 4.6 Examples

### **Recommended Books:**

1. Agarwal B. L. (2003). Programmed Statistics, second edition, New Age International Publishers, New Delhi.
2. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, Eighth Edition, Sultan Chand and Sons Publishers, New Delhi.
3. Hoel P. G. (1971). Introduction to Mathematical Statistics, John Wiley and Sons, New York.
4. Hogg, R. V. and Craig R. G. (1989). Introduction to Mathematical Statistics, Ed. MacMillan Publishing Co., New York.
5. Mayer, P. (1972). Introductory Probability and Statistical Applications, Addison Wesley Publishing Co., London.
6. Mood, A. M. and Graybill, F. A. and Boes D.C. (1974). Introduction to the Theory of Statistics, Ed. 3, McGraw Hill Book Company.
7. Ross S. (2002). A First Course in Probability, Sixth Edition, Pearson Education, Inc. & Dorling Kindersley Publishing, Inc.
8. Hanagal David D. (2009). Introduction to Applied Statistics: A non-calculus based approach. Narorse Publishing House. New Delhi



**F. Y. B. Sc.: (CBCS 2018 Course)**  
**Semester-I**  
**S- 13: Statistics Practical Course –I**

**Total Credits: 02**

**Course Learning Outcomes:**

After completion of this course students will acquire:

- i. Knowledge of drawing sample from population and draw the graphs and diagrams.
- ii. Knowledge of computing average, dispersion, moments, skewness and kurtosis for different types of data.
- iii. Knowledge of computing of various probabilities and fitting of binomial distribution.

**Course content**

**List of Practicals**

- 1 Use and Generation of random numbers.
- 2 \* Diagrammatic representation of statistical data: simple and subdivided bar diagrams, multiple bar diagram, percentage bar diagram, pie diagram.
- 3 \* Graphical representation of statistical data: histogram, frequency curve and ogive curves. Determination of mode and median graphically.
- 4 \* Computation of measures of central tendency, quartiles, Box plots.
- 5 \* Computation of measures of central tendency and dispersion (ungrouped data).
- 6 \* Computation of measures of central tendency and dispersion (grouped data).
- 7 Computation of measures of skewness and kurtosis.
- 8 Computation of moments (ungrouped and grouped data)
- 9 Fitting of binomial distribution and computation of expected frequencies.
- 10 Applications of binomial and hypergeometric distributions.