

S. Y. B. Sc.: (CBCS 2018 Course)

Semester – IV

P – 41: WAVES AND OSCILLATIONS

Total Credits: 04

Total Lectures: 60

Course Learning Outcomes:

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

1. Understanding of different forms of Wave and its dynamics
2. Acquire the knowledge of different types of oscillations
3. Concept of sound and its underlying phenomenon

Course Content:

1. Composition of two S. H. M.'s (18)

Composition of two S.H.M.s of equal frequencies along same line of vibration (analytical method only), Composition of two S. H. M.s of equal frequencies acting at right angles (analytical method with different cases), Composition of two S. H. M.'s right angles to each other (time period in the ratio 1 : 2), Lissajous figures - demonstration by mechanical, optical and electrical methods, Problems.

2. Damped Oscillations (12)

Introduction, Differential equation of damped harmonic oscillator and its solution, discussion of different cases, Logarithmic decrement, Energy equation of damped oscillations, Power dissipation, Quality, factor, Application of Damped oscillations: LCR series circuit, Problems.

3. Forced oscillations: (18)

Forced oscillations with one degree of freedom, Resonance and its examples, Equation of forced oscillations, Transient and steady state solution, log decrement, amplitude resonance and its condition, velocity resonance its condition, sharpness of resonance, energy absorption, power resonance curve, low and high frequency response, bandwidth and quality factor, forced oscillations in series LCR circuit, Problems.

4. Doppler Effect: (06)

Concept of Doppler Effect in sound, expression for apparent frequency in different cases, Asymmetric nature of Doppler Effect in sound. Doppler Effect in light (Red shift and violet shift), Symmetric nature of Doppler Effect, problems

5. Sound: (06)

Definition of sound intensity, loudness, pitch, quality and timbre, Acoustic intensity level measurement, Acoustic pressure and its measurement, Reverberation time and Reverberation of a hall, Sabine's formula (without derivation), Stroboscope, Problems,

Reference Books

1. Waves and Oscillations - by Stephenson.
2. The physics of waves and oscillations, N. K. Bajaj, Tata McGraw- Hill, Publishing co. ltd.
3. Fundamentals of vibration and waves - S. P. Puri, Tata McGraw-Hill Publishing co. ltd.
4. Waves and Oscillations, R.N. Chaudhari, New age international (p) ltd. S.Y.B. Sc.(PHYSICS)
5. Waves and Oscillation, Berkely Physics Course, Vol. III
5. Oscillation and Waves - by D. P. Khandelwal
6. College Physics Vol. II - by Narasappaya N.

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Semester – IV

P – 42: ELECTRONICS

Total Credits: 04

Total Lectures: 60

Course Learning Outcomes:

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

- Understanding of important concepts in electronics
- Knowledge of power supply, voltage, current and different circuits
- Understanding the characteristics of transistor, amplifier, oscillators and its application
- Student will be able to apply this knowledge to daily life as well as technological problems

Course Content:

1. Network Theorems: (08)

Kirchhoffs laws (revision), Voltage and Current divider circuits, Thevenin's theorem, Norton's theorem, Super-position theorem, Maximum power transfer theorem, Problems.

2. Power Supply Units: (08)

Diode as a rectifier (half wave, full wave and bridge) for determination of ripple factor and efficiency, RC filter circuit,- Unregulated and regulated power supply SMPS,

3. Bipolar Transistor: (18)

Revision of bipolar junction transistor, types, symbols and basic action, Configurations (Common Base, Common Emitter & Common Collector), Characteristic of BJT, common emitter configuration input and output characteristics, common-base configuration, output characteristics, load line concept, emitter follower, biasing methods (self bias, Potential divider etc.), and stability factor. RC coupled CE amplifier. Definition of α and β and their inter-relations, Transistor as a switch,

4. Uni-junction Transistor: (06)

Symbol, types, construction, working principle, I-V characteristics, Specifications, Parameters of- Uni-Junction Transistor (UJT), Use of UJT as a relaxation oscillator

5. Oscillators: (08)

Feedback principle, types of feedback, Basic theory of oscillator, Barkhausen,s criteria, Negative feedback in amplifier, advantages of negative feedback, multivibrators – bistable, monostable and astable.

6. Digital Electronics: (12)

Number systems: Binary, Binary coded decimal (BCD), Octal, Hexadecimal, Addition and subtraction of binary numbers and binary fractions using one's and two's complement, Basic logic gates (OR, AND, NOT), Derived gates: NOR, NAND, EXOR, EXNOR with symbols and truth tables, Boolean Algebra, De Morgan's theorems and its verification, RS flip-flop, IC 7400, IC7402, Problems. Elementary concept on nano-electronics

Reference Books

1. Electronic Devices and Circuits – Allen Mottershed (HPI)
2. Principles of Electronics – V.K. Mehta (S. Chand)
3. Basic Electronics – Grob.
4. Electronics Fundamentals and Applications – John D. Ryder
5. Electronic Devices and Circuits – Milliman and Halkins
6. Digital Principles and Applications – Malvino and Leech Tata Mc-Graw Hills Pub.
7. Electronics Principles, Malvino, 7th Edition TaTa Mc-Graw Hills.
8. Op Amp and Linear integrated circuits – Ramakant Gaikwad, Prentice Hall of India Pub
9. Introduction for nano Technology – S.K. Kulkarni

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Semester – IV
P – 43: PRACTICAL COURSE - IV

Total Credits: 02

Learning Outcome :

1. Study of circuit theorems and De-Morgan's theorems.
2. Study of I-V characteristics of UJT.
3. Measurement of A.C, and D.C. voltages by C.R.O.
4. To understand logic gates and C.R.O..
5. To know Transistor characteristics (CE configuration)

Course Content:

1. Verification of circuit theorem - Norton, Thevenin's and Maximum power transfer theorems.
2. Use of CRO - Measurement of frequency, A.C, D.C. voltages, Lissgeous figures.
3. Single stage transistor amplifier (R-C coupled).
4. I-V characteristics of UJT
5. Application of UJT as relaxation oscillator.
6. Study of astable multivibrator
7. To measure displacement (linear and angular) using potentiometer/variable inductor/variable capacitor.
8. Study of logic gates
9. Verification of De-Morgan's theorems
10. Transistor characteristics (CE configuration)
11. Study of RS flip-flop

Additional Activities (Any one)

- 1) One educational tour with report equivalent to two experiments
- 2) Demonstrations: any three demonstrations equivalent to two experiments
- 3) Mini project equivalent to two experiments
- 4) Computer aided demonstrations (Using computer simulations or animations)
(Any 1 demonstrations equivalent to 2 experiments)

Note:

- i) Students have to perform at least one additional activity in addition to eight experiments mentioned above.
- ii) Total laboratory work with additional activity should be equivalent to 10 experiments.

REFERENCE BOOKS:

1. Advanced Practical Physics - Worsnop and Flint
2. Advanced Practical Physics Vol I and 2, - Chauhan and Singh
3. Experimental Physics - Rajopadhye and Purohit
4. B.Sc. Practical Physics - C. N. Arora
5. Physics through Experiments Vol. 1, Mechanical System - B. Saraf
6. A Lab. Manual of Physics for undergraduate Students - D. P. Khandelwal
7. World Wide View of Physics - A. W. Joshi & others.

S. Y. B. Sc.: (CBCS 2018 Course)

Semester – IV

C - 41 : PHYSICAL & ANALYTICAL CHEMISTRY-II

Credits: 04

Total Lectures: 60

Course Learning Outcomes:

After completion of this course students should be able to:

1. Determine normality, molarity and molality of solution.
2. Understand theories of reaction rates.
3. Know the significance of sol, gel and emulsions.
4. Standardize the solutions .
5. Perform the acid-base, complexometric redox and iodometric titrations.

Course Content:

SECTION - I (PHYSICAL CHEMISTRY)

1. Solutions

[13]

Ways of expressing concentration, Ideal solutions, Raoult's law, vapour pressure of ideal and non ideal solutions of miscible liquids, azeotropes – HCl-H₂O and ethanol – water systems.

Partially miscible liquids – Phenol – water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature effect of impurity on consolute temperature. Immiscible liquids, steam distillation.

Ref. 7

2. Chemical Kinetics

[13]

Introduction, Simultaneous reactions such as opposing reactions, Side reactions, Consecutive reactions and chain reactions. (Derivations of rate equations for these reactions are not expected.

Effect of temperature on the rate of reaction : (i) Temperature, coefficient, (ii) Arrhenius equation, (iii) Energy of activation.

Theories of reaction rate : (i) Collision theory, (ii) Transition state theory.

Ref no. 1

3. Colloidal State

[04]

Definition of colloids, classification of colloids.

Solids in liquids (sols) : properties – kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schule law, gold number.

Liquids in liquids (emulsions): preparation and properties, inhibition, general applications of colloids.

Ref. 1 and 7

REFERENCE BOOKS:

1. Essentials of Physical Chemistry (2012), S Chand & Co. Ltd., ArunBahl, B. S. Bahl & G. D. Tuli.
2. Advanced Physical Chemistry (2011), S Chand & Co. Ltd., D. N. Bajpai.
3. Physical Chemistry, G.M.Barrow, International Student Edition, McGraw Hill.
4. Physical Chemistry, R.A.Alberty, Wiley Eastern Ltd.
5. University General Chemistry, C.N.Rao, Macmillan.
6. Physical Chemistry Through Problems, S.K.Dogra, Wiley Eastern Ltd.
7. Principles of Physical Chemistry, Samuel H. Maron, Carl F. Prutton, Fourth Edn.

SECTION – II (ANALYTICAL CHEMISTRY)

1) Introduction to Volumetric Analysis [08]

Introduction: Methods of expressing concentrations, Methods of preparation of standard solutions, primary and secondary standard substances.

Apparatus used and their calibration (burettes, volumetric pipettes, graduated pipettes, volumetric flask etc.), methods of calibration.

2) Non Instrumental Volumetric Analysis [10]

Indicators : Theory of indicators, acid base indicators, mixed and universal indicators

Acid–Base titrations: Strong acid–Strong base, Weak acid–strong base, Weak acid-Weak base titration, Displacement titrations, polybasic acid titrations.

Complexometric titrations: Principle, EDTA titrations, choice of indicators

Redox titrations: Principle of redox titration, detection of equivalence point using suitable indicators.

3) Argentometry: [6]

Theory of precipitation titration, Mohr's method, Fazan's method, Preparation and standardization of silver nitrate solution, Determination of chloride, bromide and iodide individually and in a mixture.

4) Iodometry and Iodimetry: [6]

Theory of iodometry and iodimetry, Preparation and standardization of sodium thiosulphate, Preparation and standardization of iodine solution, Determination of copper in copper sulphate, available chlorine in bleaching powder

REFERENCE BOOKS:

1. The Quantitative Inorganic Chemistry - by A.I. Vogel
2. Fundamentals of Analytical Chemistry - by S. M. Khopkar
3. Quantitative Analysis - by Day and Underwood
4. Analytical Chemistry - by G. D. Christian

S. Y. B. Sc.: (CBCS 2018 Course)
Semester – IV
C-42: ORGANIC & INORGANIC CHEMISTRY-IV

Credits: 04

Total Lectures: 60

Course Learning Outcomes:

After completion of this course students should be able to:

1. Understand the organic conversions.
2. Study of aspects of green chemistry.
3. Explain preparations, reactions and applications of aromatic nitro & amino compounds.
4. Know chemistry of carbohydrates.
5. Expound inorganic high polymers .
6. Describe acids, bases and solvents.
7. Summaries hydrogen bonding and Van-der Waals forces.
8. Express chemistry & our life.

Course Content:

SECTION – I (ORGANIC CHEMISTRY)

1. **Organic Conversions** **[10]**
Based on the knowledge of functional group Chemistry the students should be able to suggest how to bring about the given Organic conversions. The conversion should include.
 - a. Converting one functional group in to the other.
 - b. Converting a given molecule in to another with more or less number of carbon atoms.
 - c. Suggesting synthetic routs to the given targets molecule.
 - d. Suggesting the product/s at reactants and conditions are given indicating major/minor products if any.Ref. 1 & 4
2. **Green Chemistry** **[06]**
 - a) Introduction ,
 - b) 12 principles of green chemistry,
 - c) Green chemicals - Green reagents, green catalyst, green solvents.
 - d) Emerging green technologies-Microwave chemistry, Sonochemistry.
 - e) Green synthesis
 - f) Ref. 5 & 6
3. **Aromatic Nitrogen compounds** **[08]**
Aromatic nitrocompounds:
 - a. Preparation : Nitration using mixed acid, Preparation of mononitro and dinitro-compounds through nitration of benzene (mechanism), toluene.
 - b. Reactions : Reduction of nitro-compounds under different conditions.
 - c. Applications of nitro compounds : In the preparation of amines.
Aromatic amino compounds:
 - a. Preparation : Reduction of aromatic nitro compounds using catalytic hydrogenation, dissolving metal reduction using – Fe-HCl, Sn-HCl.

- b. Reactions : Basicity of aromatic amines – effect of substituents on basicity of aniline, salt formation, N-alkylation, halogenations, diazotization of aromatic primary amines

Reactions of aryl diazonium salts-Sandmeyer reactions,
Replacement of diazo group by H – OH- CN
Azo-coupling reaction with phenols/naphthols,
Ref. 1, 7 & 8

4. Introduction of Bio-molecules: [06]

Carbohydrates:

- Definition, classification, reaction of monosaccharide (glucose)- oxidation, reduction, osazone and ester formation, isomerization,
- Killiani-Fischer synthesis and Ruff degradation,
- Configuration of D/L configuration of (+) Glucose,
- Brief account of disaccharides: Sucrose and lactose.

Ref. 2

References:

- Organic Chemistry - By Morrison - Boyd (6th Edition)
- Organic Chemistry - By Finar Vol. II (5th Edition)
- Advanced organic Chemistry - By B.S. Bahl & Arun Bahl.
- Reactions, rearrangements and reagents – S N Sanyal
- Advances in green chemistry: chemical synthesis using MW irradiation by
- R.S.Varma
- Green chemistry: Environment friendly alternatives by Rashmi Sanghi and
- M.M.Srivastava
- A guide to mechanism in Organic Chemistry, 6th Edition, Peter Sykes,
- Pearson Education
- Organic Chemistry, S.H. Pine, McGraw Hill Kogakusha Ltd.

SECTION – II (INORGANIC CHEMISTRY)

1. Inorganic high polymers: [08]

Basic concepts & definitions, classification, comparison of organic and inorganic polymers, classification of inorganic polymers, polymer backbone, Polymers containing Boron, Silicon, Phosphorous, sulfur, fluorocarbons, Heteroatomic polymers, silicones, phosphonitrilic compounds PON polymers, Borazole and its derivatives.

Ref. 1 Relevant pages.

2. Acids, Bases and Solvents [08]

Definition of acids and bases, Arrhenius theory, Lowry-Bronsted theory, Lewis concept, Lux-Flood theory, strength of acids and bases, trends in the strength of hydric acids and oxyacids, Properties of solvents, M.P-B.P range, dipole moment, dielectric constant, Lewis acid-base character and types of solvents.

Ref.2. Page no. 163-173.

3. Page no. 143-170.

4. Page no. 299-322.

- 3. Hydrogen Bonding and Van-der Waals Forces** [08]
Introduction, Definition of Hydrogen bonding, conditions for formation of Hydrogen bond, strength of Hydrogen bond, Types of Hydrogen bond, Effect of Hydrogen bonding on properties of compounds like M.P, B.P, Physical state, solubility, density, viscosity. Van-der Waals forces, Types of Van-der Waals forces, factors affecting strength of Van-der-Waals forces.
Ref. 1 Page no. 256-258
- 4. Chemistry and our life** [06]
Introduction, Essential Nutrients for plants, e.g. carbon, oxygen, hydrogen, nitrogen etc., physiological role of essential elements e.g. phosphorus, potassium, manganese, sulphur, magnesium, calcium, iron, copper, boron etc., Sources of nutrients, Inorganic compounds as medicines e.g. Antacids like Sodium bicarbonate, Aluminium hydroxide gel, Aluminium phosphate, Magnesium hydroxide, platinum complex as antitumour agent.
Ref.4. Page no. 124-167.
5. Page no. 71-77.
6. Page no. 1-107 and 506-520.

References:

1. Concise Inorganic Chemistry by J. D. Lee, Fifth Edⁿ.
2. Basic Inorganic Chemistry – F. A. Cotton
3. Inorganic Chemistry- Inorganic Chemistry-Shriver and Atkins, Third Edⁿ.
4. Modern Inorganic Chemistry-P.R. Shukla, Pages-299-322
5. Environmental Chemistry-A.K.Day, Seventh Edn, Pages
6. Bioinorganic Chemistry-I. Bertini, H. Gray, Viva Low-Priced Student Edn.

S. Y. B. Sc.: (CBCS 2018 Course)
Semester – IV
C-43 : PRACTICAL COURSE - IV

Credits: 02

Course Learning Outcomes:

After completion of this course students should be able to:

1. Determine the strength of H_2O_2 using $KMnO_4$.
2. Estimate the amount of lactic acid .
3. Find out the amount of Aspirin .
4. Identify the acidic and basic radicals in the given mixture.
5. Prepare Ferrous ammonium sulphate.
6. Understand TLC techniques for separation of pigments, dyes etc.

Course Content:

A. ANALYTICAL CHEMISTRY EXPERIMENTS (Any 5)

- 1 To determine the strength of given H_2O_2 solution by using 0.05M $KMnO_4$ & hence to find out the volume strength of H_2O_2 .
- 2 To determine the amount of acetic acid from the given commercial sample of Vinegar by using standard NaOH solution.
- 3 To determine the amount of Lactic acid from the given sample of curd by using 0.05N NaOH solution.
- 4 Estimation of sodium carbonate content of washing soda.
- 5 To find out the saponification value of the given sample of an oil.
- 6 Estimation of Al (III) from the given aluminium salt solution by using Erichrome Black–T indicator (Back titration method)
7. Estimation of Aspirin from given tablet

B. INORGANIC CHEMISTRY EXPERIMENTS

Inorganic Qualitative Analysis (3 Mixtures)

Qualitative Analysis of Inorganic mixture containing two Basic and two Acidic radicals

INORGANIC PREPARATION (Any One)

- i) Preparations of Ferrous ammonium sulphate (Mohr's salt)
- ii) Synthesis of nitropenta-amino Cobalt (III) Chloride.

Laboratory techniques (Any one)

- (i) TLC:- Separation of pigments, dyes, nitroanilines.
- (ii) Isolation of Anthocyanin from flowers.

- Note:-**
- a) Double burette method should be used for all types of titrations.
 - b) Stock solutions should be supplied in 100 ml volumetric flask (10 to 15 ml)
 - c) Student must write general reactions for all tests that are performed during analysis.

REFERENCE BOOKS

1. Organic qualitative analysis - By A.I.Vogel.
2. Organic Chemistry by Finar Volume-II, 5th edition.
3. Analytical Chemistry by G.D. Christian 6th edition.
4. Vogel's Textbook of Quantitative chemical analysis 6th edition R.C. Denney, J.D. Barnes, M.J.K. Thomas

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Semester – IV

B – 41: PLANT BIOTECHNOLOGY

Core Course – Theory; Credits- 04

Total lectures- 60 L

Course Learning Outcomes :

On Completion of this course, students are able to:

1. Know the transgenic technology for the improvement of quality and quantity of plant and thereby product.
2. understand the advantages of in vitro propagation in various areas.
3. realize the application and importance ,fermentation, biogas, nanotechnology etc.
4. understand the basic concepts of genome organization in plants and molecular markers.
5. have a clear knowledge of plant tissue culture techniques
6. have a basic understanding of the plant genetic transformation methods.
7. aware of the basics and applications of plant biotechnology.
8. Understand the fundamentals of plant tissue culture techniques.

Course Content:

1. Introduction to Plant

06L

- a. Definition, concept & scope
- b. Multidisciplinary nature of Biotechnology

Fermentation Technology

09L

- a. Fermentation – Definition with one example, importance.
- b. Organisms involved.
- c. Substrate used.
- d. Products and byproducts.
- e. Concept of scaling up.
- f. Types – batch culture and continuous culture.
- g. Types of Bioreactors – Tubular tower bioreactor, digestive bioreactor, stirred tank bioreactor
- h. Various steps in manufacture of citric acid.

2. Single Cell Protein Production

9L

- a. Need of proteins in diet.
- b. Advantages and disadvantages of microbes as a source of proteins.
- c. Sources of SCP.

Wastes

Algal Biomass (*Spirulina*)

Fungal Biomass (Yeast)

4. Biological Fuel Generation

04 L

- a. Importance of biological fuel.
- b. Brief account of petrocrops.
- c. Gaseous and liquid fuels.
- d. Biogas – plant- design, operation, substrate used, biogas production, process and organisms involved.

- 5. Environmental Biotechnology** **05 L**
 a. Concept
 b. Principles of biological treatment of sewage / industrial waste water
- 6. Biotechnology in Agriculture** **07 L**
 a. Tissue culture – General techniques, methods & applications of tissue culture.
 b. Biofertilizers – Definition, necessity, types – BGA, *Azotobacter*, *Rhizobium*.
- 7. Genetic Engineering** **12L**
 a. Meaning
 b. Restriction enzymes. Plasmids, Phages.
 c. Outline of technique of genetic engineering.
 d. Transfer of genes in to plants vectors, transformation, microinjection, nuclear transplantation.
- 8. Nano – biotechnology** **08 L**
 a. Definition and concept.
 b. Chemical vs biological synthesis of nano materials.
 c. Lipid based nanobricks.
 d. Protein based nanostructure formation

Reference books:

1. Nanobiotechnology, Concepts, Applications and perspectives, C.M. Niemeyer and C.A. Mirkin ; 2004; WILEY-VCH,.
2. Bionanotechnology: concepts, Lessons from Nature”, David.S. Goodsell, 2004 Wiley-Liss
3. Nanobiotechnology Protocols; Sandra J Rosenthal, David W Wright 2005, Humana Press Inc
4. Nanoscale Technology in Biological Systems; R.S. Greco, F.B.Prinz and R.L.Smith 2005 CRC press,.
5. Fundamental Molecular Biology ; Allison LA; 2007
6. Recombinant DNA, Watson et al ; 5th Ed; 2006
7. Techniques for Engineering Genes ; Curell BR et al;2004
8. Techniques for Molecular Biology ; Tagu D &Moussard C; INRA; 2006
9. Gene Cloning and DNA Analysis ; 5th Ed ; Brown TA ; 2006
10. Analysis of Genes and Genomes ; Reece RJ ; Wiley; 2004
11. Recombinant DNA and Biotechnology ; 2nd Ed ; Kreuzer H and Massey A ;ASM;2006
12. Text book of biotechnology, R.C.Dubey, 2009, S.Chand, Delhi

S. Y. B. Sc.: (CBCS 2018 Course)

Semester – IV

B - 42: PLANT PHYSIOLOGY

Core Course – Theory; Credits- 04

Total lectures- 60 L

Course Learning Outcomes :

On Completion of this course, students are able to:

1. know importance and scope of plant physiology.
2. understand the plants and plant cells in relation to water.
3. Understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C3 and C4 pathways.
4. Understand the physiological details of photosynthesis and respiration
5. Understand lipid metabolism in plants
6. Understand the stress of plants and its adaptations.
7. Learn and understand about mineral nutrition in plants.
8. Understand the growth and developmental processes in plants.
9. Understand the process of translocation of solutes in plants.
10. Know the nitrogen metabolism and its importance..

Course Content:

Plant Physiology

1. Plant water relations

8L

Diffusion and osmosis– Definition, Process, Diffusion Pressure, DPD, OP, water potential and Chemical potential. Mechanism of water absorption, water transport through xylem,

2. Transpiration

11 L

Definition , types, mechanism of stomatal movement, factors affecting transpiration - atmospheric and edaphic factors, antitranspirants- concept and types. significance of transpiration.

3. Mineral Nutrition

08 L

Criteria of essentiality of elements, macro & micronutrients, role of essential elements, mineral deficiency symptoms and plant disorders, nutrient uptake and transport mechanism , role of cell membrane, ion pumps and carriers. Assessment of fertilizer need of the plants.

4. Transport of organic substances

04 L

Transport of photosynthates; Source-sink relationship, mechanism of translocation in phloem, assimilation process.

5. Photosynthesis

07 L

Definition and significance. Structure of photosynthetic apparatus, photosynthetic pigments, quantasomes, accessory pigments and photoprotective carotenoids; reaction center complexes , photochemical reactions, electron transport pathway in chloroplast membrane , photophosphorylation, the Calvin cycle, C4 carbon cycle, Crassulacean Acid Metabolism, Synthesis of starch and sucrose, Photorespiration.

6. Respiration

06L

Glycolysis, TCA Cycle and its regulation, electron transport in mitochondria , oxidative phosphorylation, pentose phosphate Pathway, cyanide-resistant respiration, respiratory substrates, R.Q.value.

7. Nitrogen metabolism

06L

Biological nitrogen fixation, reduction of N₂ into ammonia, *nif* genes, relation of nitrate reductase and nitrogenase, nitrate and ammonium assimilation.

8. Growth and Development

10 L

General aspects-definition, phases of growth , kinetics of the growth , physiology of seed dormancy and seed germination, concept of photoperiodism, physiology of flowering , the florigen concept & role of hormones, vernalization , senescence and fruit ripening, physiological role and mechanism of action of hormones, Auxins, Cytokinins, Gibberellins, Abscisic acid and Ethylene.

Reference books:

1. Galston,A.W. 1989, Life Processes in plants, Scientific American Library, Springer-Verlag, New York, USA.
2. Hooykaas,P,J,J, Hall, M.A. and Libbenga, K.R.(eds) 1999. Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam, The Netherlands.
3. Hopkins, W.G. 1995. Introduction to plants Physiology. John Wiley and Sons, inc., New York, USA.
4. Moore. T.C.1989. Biochemistry and Physiology of Plant Hormones (2nd edition) Springer-Verlag, New York, USA.
5. Salisbury, F.B. and Ross, C.W.1992. Plant Physiology (4th edition) Wadsworth Publishing Co. California, USA.
6. Taiz,L. and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc.,Publishers, Massachusetts, USA.

S.Y.B.Sc. (CBCS – 2018 Course)
SEMESTER - IV
B 43 - Botany Practical course IV
(Practical based on paper: B-41, B-42 (SEM - IV))

Core Course – Practical; Credits- 02

Contact hours per practical – 04 h

(ANY-10)

Course Learning Outcomes :

On Completion of this course, students are able to:

1. determine the DPD by using the potato tuber
2. determine the rate of photosynthesis · Determination of RQ using Ganong's respirometer
3. understand osmosis by curling experiment, Imbibition pressure, Thistle funnel, Ringing experiment, Relative transpiration, CO₂ necessary for photosynthesis, Kuhlen's Tube experiment, Cyclosis in Hydrilla
4. determine the absorption spectrum of chlorophyll pigments and estimate the amount of Chl-a, Chl-b and total Chlorophylls by spectrophotometer method.
5. Study extraction and separation of free amino acid of germinating seed by circular paper chromatography.
6. Extraction and Detection of secondary plant metabolites from suitable plant material.
7. study the activity of enzyme lipase in germinating seeds.

Course content:

PLANT BIOTECHNOLOGY

1. Demonstration of DNA Model. **D**
2. Demonstration of comparison of GM Plants with Non- GM Plants.
(BT cotton, BT Tomato) **D**
3. Estimation of citric acid by assay method. **E**
4. Cultivation of *Spirulina* and Study of its commercial products. **E**
5. Plant tissue culture technique. **E**
A) Instrumentation, Sterilization, Media preparation
B) Inoculation of Explants / Meristem / Nodal sector / Embryo
6. Visit to biotechnology institute and submission of visit report with respect to design of PTC lab.
7. Demonstration of synthetic seeds. **D**
8. Visit to waste water treatment plant and submission of its report.

PLANT PHYSIOLOGY

9. To study the permeability of plasma membrane using different concentrations of organic solvents. (Potato tuber experiment) **E**
10. To extract enzymes and study their activity, e.g. amylase, lipase, acid Phosphatase, Catalase, Peroxidase – **E**
11. To extract and separate chloroplast pigments by solvent method and demonstrate fluorecence in chloroplast extracts.- **E**
12. To determine stomata index, stomatal frequency and percentage of leaf area open through stomata. **E**
13. To determine the rate of transpiration in different conditions (sunlight, shade, wind) by using students potometer. **E**

D – Demonstration, E – Experiment

Suggested Readings (for laboratory exercises)

- Copeland, R.A 1996, Enzymes: A Practical introduction to Structure, Mechanism, and Data Analysis. VCH Publisher, New York.
- Dryer, R.L. and Lata, G.F. 1989, Experimental Biochemistry. Oxford, University Press, New York .
- Moore, T.C. 1974. Research Experience in plant Physiology. A Laboratory Manual. Springe-Verlag, Berlin.
- Wilson, K. and Goulding , K.H. (Eds)1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold, London, Uk.
- Practical Botany-S. B. Agarwal
- A Mannual in Plant Physiology Practical –Vaidya&Kulkarni
- Practical Botany- By S C Santra, Vol. 1, Vol. 2, New Central Book Agency (P) Ltd., Kolkata.

N.B.

- Visits to Agriculture college/ Horticulture college/ Research centers / Biofertilizer industries/ Mushroom cultivation centre.
- Botanical collections. (One in each term).
- Students should submit tour and visit reports .

S.Y.B.Sc. (CBCS – 2018 Course)
SEMESTER - IV
Z 4 1 : Functional Anatomy of Chordates-II

Total Credits: 04

Total lectures: 60

Course Outcomes:

On completion of the course, students are able to:

1. Understand the systematic position and external morphology of *Scoliodon*.
2. Understand and study the various systems like digestive system, respiratory system, nervous system in *Scoliodon*.
3. Study and understand the classification and characters of animals in various classes- Reptiles, Aves and Mammals.
4. Gain knowledge about diversity of animals in class Reptiles, Aves and Mammals.
5. Study and understand aerial adaptations in birds.
6. Impart and understand knowledge about poisonous and non-poisonous snakes.
7. Understand and study beak and leg modifications in birds.
8. Study and understand dentition in mammals, dental formula in with some examples.
9. Gain knowledge about animal ethics, animal protection act and its applications.

Course Content

UNIT I

Study of *Scoliodon*

20L

- i) Systematic position, habit and habitat.
- ii) External characters of *scoliodon*
- iii) Digestive system, food and feeding
- iv) Respiratory system
- v) Blood vascular system – Heart, Its structure and working
- vi) Nervous system -Brain its structure and functions
- vii) Sense organs – Olfactory organs, eye, membranous Labyrinth, Ampulla of lorenzini
- viii) Urinogenital system – Male and Female
- ix) Economic importance of *Scoliodon*

UNIT II

Salient features of the following classes and its subclasses with suitable two examples of each

15L

- i) Reptilia: Subclasses- Anapsida, Diapsida
- ii) Aves: Subclasses- Neornithes- Superorders- Palaeognathae, Neognathae
- iii) Mammalia: Subclasses-Prototheria, Theria- Metatheria, Eutheria

UNIT III

General topics

20L

- i) Poisonous and Non- poisonous snakes (Two examples each)
- ii) Beak and Feet modifications in birds
- iii) Aerial adaptations in birds
- iv) Dentition in mammals

UNIT IV

05L

Animal Ethics

- i) Introduction and Concept
- ii) Animal Protection Act
- iii) Laboratory animal model and application(Any four)

Reference books :

1. Chordate Zoology (1988) – C.Dalela.
2. Chordate Zoology (1996) , Kishor Pawar.
3. Zoology of chordates – H.C. Nigam.
4. The diversity of life – E.O.Wilson.
5. The biology of diversity – M.kato.
6. Modern text book of zoology – vertebrates (1992) – Kotpal ,Agarwal and Khetarpal.
7. Text book of Modern Zoology (1991) – P.S. Verma and P.C. Shrivastava.
8. Mannual of practical zoology – vertebrates – P.S. Verma.
9. The Life of Vertebrates – Younge J. Z.
10. A Textbook of Zoology –Parker T.J. and Haswell W. A..
11. A Textbook of vertebrate Zoology – Prasad S. N.
12. Introduction to chordates – Manjupuria T. C.
13. A Textbook of vertebrate Zoology- Agarwal and Dalela.
14. Vertebrates – Kotpal R. C.
15. Chordates – Dhami and Dhami.
16. Wild life conservation: Negi S.S (Natraj Publishers)
17. Guidelines for breeding and care of laboratory animals: World Health Organization (WHO) and International Council For Laboratory Animal Science (ICLAS).

S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER IV
Z 4 2 : Physiology of Mammals

Total Credits: 04

Total lectures: 60

Course Outcomes:

On completion of the course, students are able to:

1. Impart the knowledge about various metabolic and physiological mechanisms of the human body.
2. Understand the physiology at the cellular and system level and describe the role and functions of different systems.
3. Understand the structure and function of carbohydrates, proteins, amino acids, lipids, vitamins and minerals as a constituents of balanced diet.
4. Describe and study the physiology of digestive system, respiratory system, circulatory system, endocrine and reproductive system to define normal and abnormal functions.

Course Content

UNIT I

15L

Nutrition

- i) Constituent of balanced diet-
Carbohydrates, Fats, Proteins, Essential Amino acids, Vitamins, Mineral Salts, Water
- ii) Brief outline of sources of energy –
Carbohydrates and carbohydrate requirements, Fats and its requirements, Protein and its requirements.
- iii) Physiology of digestion –
Peristaltic movement, digestion, actions of digestive juices and enzymes on different foods, absorption, assimilation, defecation.

UNIT II

06L

Circulation

- i) Process of coagulation of blood
- ii) Neurogenic and myogenic heart, cardiac cycle, cardiac output
- iii) Control of heart beats – Nervous, Hormonal and Ionic

UNIT III

10L

Respiration

- i) Ventilation
- ii) Nervous control of breathing action
- iii) Exchange of gases between lung and plasma, erythrocytes and tissues
- iv) Basal metabolic rate and respiratory quotient

UNIT IV

08L

Excretion

- i) Formation and composition of urine
- ii) Counter current multiplier theory
- iii) Blood supply of kidney
- iv) Hormonal control of kidney

UNIT V

08L

7. Reproduction

- i) Oestrous cycle and Menstrual cycle
- ii) Pregnancy
- iii) Parturition
- iv) Hormonal control

UNIT VI

13L

9. Vertebrate endocrinology

- i) Pituitary gland hormones :
Pars distalis – S. T. H. / G. H, Prolactin, TSH, FSH, LH, ICSH, ACTH
Pars intermedia – MSH
Pars nervosa – Oxytocin, ADH
- ii) Thyroid gland – Thyroxin, Calcitonin
- iii) Adrenal gland hormones :
Adrenal cortex – Mineralocorticoid, Glucocorticoid
Adrenal medulla – Adrenalin, Nonadrenalin
- iv) Pancreas (Islets of Langerhans) – Insulin, Glucagon.
- v) Kidney (JG Complex)– Renin, Erythropoitin
- vi) Testis (Cells of Leydig) – Testosterone.
- vii) Ovary : Theca interna Oestrogen, Corpus luteum -Progesterone

Reference books :

1. General & Comparative Physiology – By Hoar W.S.
2. An introduction to physiology – Davson (Vol.I & II)
3. Human Physiology – Chatterjee C C (vol. I & II)
4. Textbook of animal physiology – Hmkat & Mathur.
5. Human physiology – Guyton and Hall.
6. Mammalian Phyiology – Athavale M.V.
7. Zoology – General Physiology – Pradip Jabde (vol. I &II)
8. Physiology of Reproduction – Hogarth.
9. General & Comparative endocrinology – E.J. W. Barrington.
10. Text book of Endocrinology –R.H. Williams.

S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER IV
Z 43 : Zoology Practical course
(Practical based on paper: Z-41, Z-42)

Total Credits: 02

Contact hours per practical – 04 h

Course Outcomes:

On completion of the course, students are able to:

1. Understand the classification, characters and diversity of animals in various classes- Reptiles, Aves and Mammalia with the help of museum specimens.
2. Understand the systematic position and external morphology of *Scoliodon*.
3. Understand and study the various systems like digestive system, respiratory system, nervous system in *Scoliodon*.
4. Understand and study beak and leg modification in birds with the help of museum specimens.
5. Identify characters of poisonous and non- poisonous snakes with the help of museum specimens and photographs.
6. Study and understand dental formula, dentition in mammals.
7. Study and understand effect of enzyme on food material like carbohydrates, proteins with the help of biochemical tests.
8. Study measurement of Hb % of human (mammalian) blood.
9. Study and counting W.B.Cs and R.B.Cs of human (mammalian) blood.

Course Content

Functional anatomy of chordates-II

1. Study of general and distinguishing characters and classification of chordates upto order level with one example of each order. **D**
(Sketches/Photographs may be used)
 - a. Class – Reptilia (Order : Chelonia, Squamata- Lacertilia, Ophidia, Crocodilia)
 - b. Class- Aves (Order : Struthioniformes, Anseriformes, Falconiformes, Psitaciformes, Passeriformis and Columbiformes)
 - c. Class – Mammalia (Order : Monotremata, Marsupialia, Chiroptera, Rodentia and Primates)
2. Study of systematic position, external features and digestive system of *Scoliodon*. **D**
3. Study of brain of *Scoliodon*. **D**
4. Study of placoid scales and ampullae of Lorenzini. **D**
5. Study of a) Arterial system of *Scoliodon* (excluding head arteries) **D**
b) Eye ball muscles **D**
6. Identification of poisonous and non- poisonous snakes with the help of identification key with two examples of each **D**
7. Study of modifications of beaks and feet in birds. **D**
 - a. Beaks: tearing and piercing, fruit eating, mud probing, fish catching, wood chiselling and flower probing.
 - b. Feet: perching, raptorial, climbing, swimming, running.
8. Dentition in mammals. **D**

Physiology of Mammals

9. Action of Enzymes . **E**
 - a. Digestion of starch by saliva/ proteins by pepsin.
 - b. Effect of temperature and dilution on enzyme action.
 - c. Specificity of enzyme.
10. Quantitative estimation of hemoglobin in blood and study of colour index. **E**
11. Study of total count of R. B. C. in mammalian blood. **E**
12. Study of total count of W. B. C. in mammalian blood. **E**
13. Study of clotting time by capillary experiment. in mammalian blood. **E**
14. Compulsory submission of field visit report along with at least five photographs/ models/ sketches of insect pest/fishes/any animal corresponding to theory courses.
15. Compulsory study tour/visit to sea coast/fishery institute/sericulture farm/ apiculture institute / agricultural farm.

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

***E** – Experiments

***D** – Demonstration Practical

Reference books :

1. A Manual of Practical Zoology Chordata Vol. 2 : P. K. G. Nair and K. P. Achar.
2. A Manual of Practical Vertebrate Zoology and Physiology, 1990. V. B. Rastogi, Kedarnath, Ramnath, Meerut, Delhi.
3. Experimental Physiology: V.V. Kulshreshtha, Vikas Publishing House Pvt. Ltd, New Delhi.
4. Practical Zoology, Vertebrate : S.S. Lal Rastogi Publications, Meerut.

S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER IV

MB –41 Principles of Disease, Epidemiology and Immunology

Total credits 04

Total 60 Lectures

Course Outcomes:

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

1. Understand principles of disease, epidemiology and immunology.
2. Understand different modes of transmission of diseases.
3. Know different components of immune system and their functions.

Course Content

No. of lectures

I)	Microorganisms and Disease	(16)
	i) Distribution and Occurrence of the normal flora ii) Pathogenicity, virulence and infection iii) Types of infectious diseases iv) Role of host in infectious Diseases Types of carriers: Convalescent, healthy, casual and chronic v) Airborne Transmission of the diseases a) Concept of Droplets & Droplet Nuclei b) Aerosols vi) Waterborne Transmission of the diseases vii) Food borne Transmission of the diseases viii) Transmission by Direct Contact ix) Arthropod borne Transmission	
II)	Immune Response Mechanisms:	(07)
	i) Types of Immunity:	
	a) Innate or natural immunity b) Acquired immunity – Active Immunity, Passive Immunity	
	ii) Components of Immune system:	(25)
	a) Phagocytic cells, Eosinophils, Neutrophils, Macrophages, Natural Killer Cells b) Antigens : Definition , Haptens, Carrier Proteins, Sequential Epitopes, Conformational Epitopes, Continuous Epitopes, Discontinuous Epitopes. c) Antibodies: Structure & functions of IgG, IgM, IgA, IgD and IgE d) Monoclonal antibodies: Definition and applications.	
	iii) Adjuvants	(02)
III)	Complement System:	(10)
	i) Classical Pathway ii) Alternative Pathway iii) Biological Significance of Complement Factors	

References :-

1. Robert F. Boyd 1995, General Microbiology Times Mirror/Mosby College Publishing(Topic No.II)
2. Michael J. Pelzar ‘ Microbiology’ 11th reprint Tata McGraw Hill Delhi(Topic No.I)
3. Abul K. Abbas 2006 Cellular & Molecular Immunology 5th Edition S.awnders, Philadelphia(Topic No.III)
4. David Male , Jonathan Brostorr, davidB.Roth Nan Roitt 2006, Immunology 7th Edition Elsevier UK/ USA(Topic No.III)
5. R.Anantnarayan, C.K.JayaramPaniker (2009), ‘Text Book of Microbiology’ ,8th Edition, University Press India Pvt.Ltd. India. (Topic III)

S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER IV
MB – 42 Applied Microbiology

Total credits 04

Total 60 Lectures

Course Outcomes:

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

1. Understand different aspects of microbial pollution of water.
2. Know different ways of water treatments.
3. Understand basics of microbial fermentation techniques.

Course Content

No. Of lectures

I)	Water Microbiology i) Water related illnesses associated with microorganisms a) Bacteria, Blue – green Algae, Parasites – Protozoa, Nematodes, b) Cestodes, Trematodes. Emerging pathogens, Viruses c) Opportunistic Bacterial pathogens ii) Indicator microorganisms: a) Concept of Indicator organisms b) Standard and Criteria for indicators c) Fecal coliforms d) Fecal <i>Streptococci</i> , <i>Clostridium perfringens</i> , <i>Bifidobacterium bifidus</i> e) Bacteriophages iii) Total coliforms: The most Probable numbers (MPN) Test, The Presence Absence (P-A) test iv) Domestic waste water treatment a) Domestic Wastewater: composition b) Modern Wastewater Treatment: Primary Treatment, Secondary c) Treatment, Tertiary Treatment: Activated sludge and Trickling Filter d) Removal of BOD and COD by sewage Treatment Processes e) Sludge Processing, Oxidation Ponds, Septic tanks v) Potable water treatment and distribution a) Water Treatment Processes-Physical and Chemical b) Thermal Destruction, Factors Affecting Disinfectants c) Disinfection by different agents: Halogens, Ozone, d) Metal ions, Ultraviolet Disinfection, Photodynamic Inactivation e) Gamma and High Energy inactivation	30
II)	Industrial Microbiology i) Introduction and history: Fermentation – concept ii) Fermenter and its parts a) Vessels Used for fermentation, b) <i>In situ</i> Sterilization of Fermenter and its parts iii) Organisms used in fermentations a) Primary and Secondary screening, b) Stock Culture and Inoculum preparation	30

- iv) Media used in fermentation
 - a) Different Raw materials used as a substrate
 - b) Screening, Pretreatment and Sterilization of media
- v) Control of contamination in fermentations
- vi) Buffers and antifoam agents
- vii) Different types of fermentations –
 - a) Dual and multiple b) Batch and continuous
- viii) Production of antibiotics: - Organisms, Medium Composition, Precursors, Process and Flow sheet, Recovery & purification.
 - a) Streptomycin
 - b) Penicillin and Semi synthetic Penicillins

Reference:

1. Casida L.E. Jr. (1983) – Industrial Microbiology. Wiley eastern limited, New Delhi.
2. Maier R.M., I.L.Pepper, C.P. Gerba (2000) Environmental Microbiology Academic Press. Chapter No. 19, 20,21,22,23.
3. Patel A.H. (1985) – Industrial Microbiology Mac Milan India Ltd.
4. Peppler H. H. (Ed) (1979) – Microbial Technology Vol I & UU Academic Press, New York.
5. Peppler periman II (Ed) (2004) – Microbial Technology. Microbial Processes Vol I & II Academic Press: Published by Elsevier. Chapter 3 (Vol.II)
6. Prescott S. C. & C. G. Dunn (1983) Industrial Microbiology 4th edition edited by Gerald Reed. AVI Tech Books USA. Chapter 13, (Vol. I)
7. Stanbury P.F. & A Whitaker (1984) – Principles of Fermentation Technology. Pergamon, New York. Chapter No. 4,5,6,7,9.

S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER IV
MB- 43: Practical Course
(based on MB 41, MB 42)

Total credits: 02

Course Outcomes:

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

1. Develop the skills for detecting drug resistance among bacteria.
2. Improve the skills for blood grouping and blood banking procedures.
3. Develop the skills for detecting potability of water and water pollution.

Course Content:

I. Study of Medical Microbiology and Immunology. (06)

- i) Antibiotic sensitivity test.
- ii) Isolation of micro flora of skin
- iii) Isolation of oral micro flora.
- iv) Detection of ‘Human Chorionic Gonadotrophic Hormone from urine.
- v) Detection of blood group antigens using appropriate antibodies and its clinical significance.
- vi) Visit to blood bank and submission of report.

II. Microbiology of Water. (15)

- i) Bacteriological examination of water (Qualitative test)
 - a) Presumptive
 - b) Confirmed
 - c) Completed test.
- ii) Standard Plate Count test (Quantitative)
- iii) Determination of Most Probable Number (MPN)
- iv) Determination of DO.
- v) Determination BOD.
- vi) IMViC tests:-
 - a) Indole production
 - b) Methyl Red Test.
 - c) Vogues Proskauer test.
 - d) Citrate Utilization test.

References:–

1. Bradshaw L. Jack (1979) Laboratory Microbiology, 3rd Edition W.B. Saunders co Philadelphia, London, Toronto.
2. Benson H.J. (1990) Microbiological Applications A Laboratory manual in General Microbiology, 5th Edition Wm. C Brown Publisher.
3. Cappuccino J.G. and N. Sharma (2004) Microbiology A Laboratory manual Sixth Edition.
4. Cruickshank R and J.P. Duguid (1980) Medical Microbiology Volume II, 12th Edition. The Practice of Medical Microbiology, Churchill Livingstone Edinburgh, London and New York.
5. Pelczar M.J. and E.C. Schwann (1972) Laboratory. Exercise in Microbiology 3rd Edition (Practical Manual Tata McGraw Hill) Edition New Delhi.
6. Sharma K. (2005) Manual of Microbiology Tools & Techniques Anne Book New Delhi.

S. Y. B.Sc. (CBCS - 2018 Course)
SEMESTER IV
M-41 : Vector Calculus

Total Credit: 04

Total Lectures: 60

Course Learning Outcomes:

1. At the end of this course students are expected to be able to:
2. Understand the concepts of vector functions of one and several variables, partial derivatives etc.
3. Understand the concepts of Gradient of scalar point function, Divergence and curl of a vector point function.
4. Surface integral, line integral, volume integral, Green's theorem, Gauss's divergence theories, Stoke's theorem.

Course content:

Unit-01: VECTOR FUNCTIONS OF ONE VARIABLE :

1. Vector valued functions.
2. Limits and continuity of vector valued functions.
3. Differentiability of vector valued functions.
4. Theorems on derivatives.
5. Curves in space.
6. Tangent vector and normal plane.

Unit-02: VECTOR FUNCTIONS OF SEVERAL VARIABLES

1. Vector functions of several variables.
2. Limit and continuity of vector functions.
3. Partial derivatives for vector functions of two and three variables.
4. Total Differential.

Unit-03: DIFFERENTIAL OPERATORS. :

1. Scalar field, vector field, level surfaces.
2. Gradient of scalar point function and its geometrical interpretation.
3. The directional derivative of a scalar point function.
4. Divergence of a vector point function.
5. Physical Interpretation of divergence.
6. Curl of a vector point function.
7. Physical interpretation of curl.
8. Properties of gradient, divergence and curl
9. Solenoidal and irrotational vector fields.

Unit-04: VECTOR INTEGRATION.

1. The vector integration.
2. Line integrals.
3. Conservative vector field and theorems based on conservative vector fields.
4. Surface integrals.
5. Volume integrals.

6. Green's theorem in the plane (with proof)
7. Gauss's divergence theorem (without proof)
8. Stoke's theorem (without proof)
9. Examples of integrals and theorems based on sphere cube, cylinder, square.

Reference Books :-

1. Shanti Narayan, A Course of Mathematical Analysis.
2. M.R. Spiegel; Advanced Calculus, Schaum series.
3. David V. Wider, Advanced Calculus, second edition; Prentice Hall of India, New Delhi.
4. John M.H.Olmsted, Advanced Calculus, Euresia Publishing House, New Delhi.
5. T.M. Apostol; Calculus, Vol - 2 , 2nd Edition, John Wiley.
6. Shanti Narayan; A text Book of Vector Analysis.
7. W.Kaplan; Advanced Calculus; Addison - Wiley, Reading Mass 1952.
8. J.E. Marsdan and A.J. Tromba, Vector Calculus, fourth Ed; W.H. Freoman and Co. New York.
9. Monty J.Strauss, Gerald L. Bradley, Karl J Smith, Calculus (3rd Edition); Pearson Education

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S.Y.B.Sc. (CBCS 2018 Course)
Semester – IV
M-42 : Complex Variables

Total Credit: 04

Total Lectures: 60

Course Learning Outcomes:

1. At the end of this course students are expected to be able to:
2. Understand the concepts of functions of complex variables, Cauchy Riemann equations.
3. Understand the concepts of complex integrals, Cauchy theorem, Cauchy's integral formulae etc.
4. Concepts of Calculus of residues.

Course content :

Unit-01: FUNCTIONS OF COMPLEX VARIABLES :

1. Definition and examples, Limit, theorems on limits, Continuity, theorems on continuity.
2. Derivative : Differentiable functions, Algebra of differentiable functions.
3. Chain rule (without proof).
4. Analytic functions.
5. Cauchy - Riemann equations. Necessary condition (with proof). sufficient condition (without proof)
6. Harmonic functions : Real and imaginary parts of an analytic functions are harmonic (proof)
7. To find an analytic function if either real or imaginary parts are given.
8. Milne - Thomson Method for construction of analytic function.

Unit-02: COMPLEX INTEGRALS :

1. Contour integration. Simple arc. Line integral.
2. Statement of Cauchy Goursat theorem and examples for verification.
3. Simply and multiply connected regions, Antiderivatives and independence of path definition and examples.
4. Statements of Cauchy's integral formulae (without proof).
5. Taylor series and Laurent's Series (statements only).
6. Zeros of an analytic functions

Unit-03: CALCULUS OF RESIDUES :

1. Definition and examples of residues of a function.
2. Poles of a function. Simple and double pole.
3. Residue of a pole.
4. Residue of $f(z)$ at $z=a$ is $\lim_{z \rightarrow a} (z - a) f(z)$ (proof).
5. Cauchy's residue theorem (With proof)
6. Evaluation of contour integrals of the following form.
 - a) Examples using Cauchy's residue theorem.
 - b) $\int_0^{2\pi} f(\cos \phi, \sin \phi) d\phi$, integration round the unit circle.

- c) Evaluation of definite integral of the type $\int_{-\infty}^{\infty} f(x) dx$, where $f(x) = \frac{P(x)}{Q(x)}$ and $P(x)$ and $Q(x)$ are polynomials in x .
- d) Evaluation of $\int_0^{\infty} f(x) dx$, when $f(x)$ is even.
- e) Evaluation of $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \sin mx dx$ and $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \cos mx dx$ where $P(x)$ and $Q(x)$ are polynomials.
(Note - Examples involving simple poles only)

Reference Books :-

1. Shanti Narayan : Theory of Functions of Complex variables S. Chand & Co.
2. R.K.Gupta, J.N.Sharma : Complex Analysis; Krishna Prakashan Mandir, Meerat (U.P.)
3. M.L. Khanna : Complex Analysis.
4. R.V. Churchill ; Complex Variable and Applications; McGraw Hill (1984)
5. Agashe, Kulkarni, Chirptkar : Complex Variables, Narendra Prakashan.

S.Y.B.Sc. (CBCS 2018 Course)

Semester – IV

M-43: Mathematics Practical Course – IV

(Practicals based on the applications and Problems of articles in M-41 and M-42)

Total Credit :02

Course Learning Outcomes:

1. At the end of this course students are expected to be able to:
2. Finding the partial derivatives of functions of two and three variables.
3. Finding curl, div and gradient of scalar functions.
4. Use of Green's theorem, Gauss divergence theorem and Stokes theorem.
5. Finding analytic functions and verification of analyticity of function.
6. Solving the integrations using the Cauchy's integral formula.
7. Finding the Taylor's and Laurent series of complex valued functions.

List of Practical:

- 1) Partial derivatives for vector functions of two and three variables.
- 2) Gradient of scalar point function, divergence of vector point function and curl of vector point function.
- 3) Obtaining scalar point function at given point whose gradient is given.
- 4) Volume Integrals.
- 5) Green's theorem, Gauss's divergence theorem and Stoke's theorem.
- 6) Obtain an analytic function if either real or imaginary parts are given.
- 7) Cauchy's integral formulae.
- 8) Taylor's and Laurent's series.
- 9) Contour integration by Cauchy's residue theorem.
- 10) Evaluation of $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \sin mx dx$ and $\int_{-\infty}^{\infty} \frac{P(x)}{Q(x)} \cos mx dx$.

S.Y.B.Sc(CBCS 2018 Course)
Semester – IV
S-41:Probability Distributions and Statistical Inference-II

Total Credit: 04

Total Lectures: 60

Course Learning Outcomes:

After completion of this course students will acquire:

1. Knowledge of tests of hypothesis and its associated concepts.
2. Concept of Fisher's Z transformation and its applications.
3. Concept of confidence interval and confidence coefficient.
4. Knowledge about time series data, its applications to various fields and components of time series.
5. Introduction and advantages of most important tools of statistics of statistical quality control mostly used in industry at various stages.

Course content:

Unit - 1 : Test of significance.

1.1 Notion : Statistical hypothesis, null and alternative hypothesis, one sided two sided alternatives. Test of hypothesis, critical region, Type I error and Type II error level of significance.

1.2 Large sample tests for.

$$H_0 : \mu = \mu_0 \text{ against } H_1 : \mu \neq \mu_0.$$

$$H_0 : \mu_1 = \mu_2 \text{ against } H_1 : \mu_1 \neq \mu_2.$$

$$H_0 : P = P_0 \text{ against } H_1 : P \neq P_0.$$

$$H_0 : P_1 = P_2, \text{ against } H_1 : P_1 \neq P_2.$$

1.3 Examples

Unit - 2 : Application of Fisher's Z transformation.

2.1 Fisher's Z – transformation.

2.2 Testing of hypothesis :

i) $H_0 : \rho = \rho_0$ against $H_1 : \rho \neq \rho_0$.

ii) $H_0 : \rho_1 = \rho_2$ against $H_1 : \rho_1 \neq \rho_2$.

2.3 Examples

Unit - 3 :Interval Estimation .

3.1 Concept of confidence interval and confidence coefficient.

3.2 Confidence intervals for the parameters of univariate normal, two independent normal, confidence interval for proportion.

3.3 Examples

Unit - 4 : Time Series

- 4.1 Meaning and usefulness of time series analysis.
- 4.2 Components of a time series : trend, seasonal, cyclical and irregular.
- 4.3 Methods of estimating trend.
 - i) Method of moving averages.
 - ii) Method of least squares.
- 4.4 Methods of estimating seasonal component.
 - i) Method of averages.
 - ii) Ratio to trend obtained by moving average.
- 4.5 Examples and problems.

Unit - 5 : Introduction to Statistical Quality Control (S. Q. C.)

- 5.1 Introduction and need of SQC.
- 5.2 Concept of control charts, construction of \bar{x} and R charts when standards are given and not given.
- 5.3 Advantages of Statistical Quality Control.
- 5.4 Examples.

Books Recommended

1. Hogg R. Y and Craig A. J. Introduction of Mathematical Statistics.
2. Snedecor & Cochran - Statistical methods.
3. D. Montgomery (Wiley & Sons) Introduction of Statistical Process Control.
4. BIS - Publication - Statistical Quality Control (Hand Book).
5. Mood A. M., Graybill F. A., Bose F. A. - Introduction to theory of Statistics (Third Edition).
6. Duncon A. J. - Quality control and Industrial Statistics.
7. Kelkar M. K. - Mathematical Methods (Narendra Prakashan, Pune).
8. A. R. Chandekar - Statistical Methods.
9. Meyer P. L. - Introductory Probability and Statistical Applications.
10. Kenney and Keeping - Mathematics of Statistics.
11. Gupta S. C. and Kapoor V. K. - Fundamental of Applied Statistics.
12. B. R. Bhat, T. Srivenkataramana Mahava Rao - Statistics (Vol - I and II) (New Age International Published).
13. Rao C.R. (1973); Linear Statistical inference and its Applications, Revised Edition, Wiley Eastern.
14. Rohatgi V.K. : (1986) : An Introduction to Probability Theory and Mathematical Statistics Wiley Eastern.
15. Hanagal David D. (2009). Introduction to Applied Statistics: A non-calculus based approach. Narosa Publishing House.

S.Y.B.Sc(CBCS 2018 Course)
Semester – IV
S-42:Probability Distribution and Statistical Methods-II

Total Credit: 04

Total Lectures: 60

Course Learning Outcomes:

After completion of this course students will acquire:

1. Knowledge of multiple linear regression.
2. Knowledge of multiple correlation coefficient and partial correlation coefficient including their properties and its applications.
3. Knowledge of important continuous distributions such as t-distribution and F-distribution.
4. Acumen to apply t-distribution and F-distribution to different situations.
5. Idea about the table value of t-distribution and F-distribution.

Course content:

Unit - 1 : 't' Distribution and Application of t distribution.

1.1 Definition of t with p. d. f. in the form

$$t = \frac{U}{\sqrt{\chi_n^2/n}}, \quad \text{where } U \sim N(0,1) \text{ and } \chi_n^2 \text{ is a } \chi^2$$

with n. d. f. are independent random variables.

1.2 Derivation of p. d. f. and nature of probability curve.

1.3 Mean, variance and moments. Statement of Normal approximation.

1.4 Use of t table for calculation of probabilities.

1.5 Test for

- i) $H_0 : \mu = \mu_0$ against $H_1 : \mu \neq \mu_0$.
- ii) $H_0 : \mu_1 = \mu_2$ against $H_1 : \mu_1 \neq \mu_2$.
- iii) $H_0 : \rho = 0$, against $H_1 : \rho \neq 0$

1.6 Paired Comparison.

1.7 Examples and problems.

Unit - 2 : 'F' Distribution and Application of F distribution.

1.1 Definition of F with n_1 and n_2 degrees of freedom as

$$F_{n_1, n_2} = \frac{\chi_{n_1}^2/n_1}{\chi_{n_2}^2/n_2} \quad \text{where } \chi_{n_1}^2 \text{ and } \chi_{n_2}^2$$

are independent chi - square variate with n_1 and n_2 d. f. respectively.

1.2 Derivation of p. d. f., and nature of probability curve.

1.3 Mean, variance, mode and moments.

1.4 Use of F tables for calculation of probabilities.

1.5 Interrelations among normal. Chi - square, t and F variates.

1.6 F – test for

$$H_0 : \sigma_1^2 = \sigma_2^2 \text{ against } H_1 : \sigma_1^2 \neq \sigma_2^2$$

1.7 Examples and problems.

Unit - 3 : Multiple Linear Regression and Multiple and Partial Correlation.

- 3.1 Notation of multiple linear regression, Yule's notation.
- 3.2 Fitting of regression planes by method of least square, obtaining, normal equations, solution of normal equations by Cramer's rule, representation in determinant form, definition of partial regression coefficient $b_{ij.k}$.
- 3.3 Residuals : definition, order, derivation of variance and covariance.
- 3.4 Interpretation of partial regression coefficients.
- 3.5 Definition of multiple correlation coefficient $R_{i.jk}$. as the correlation coefficient between a variable and its best linear predictor.
- 3.6 Derivation of the formula for the multiple correlation coefficient in terms of cofactors of correlation matrix.
- 3.7 Properties of multiple correlation coefficient.
- 3.8 Interpretation of (a) $R_{i.jk}$ as proportion of variation explained by the linear regression. (b) $R_{i.jk} = 1$ (c) $R_{i.jk} = 0$.
- 3.9 Definition of partial correlation coefficient $r_{ij.k}$ as correlation coefficient between residuals.
- 3.10 Derivation of the formula for $r_{ij.k}$ in the terms of the cofactors of the correlation matrix.
- 3.11 Properties of partial correlation coefficient.
a) $-1 \leq r_{ij.k} \leq 1$ b) $b_{ij.k} b_{ji.k} = r_{ij.k}^2$
- 3.12 Examples and Problems.

Books Recommended

1. Hogg R. Y and Craig A. J Introduction of Mathematical Statistics.
2. Snedecor & Cochran - Statistical methods.
3. D. Montgomery (Wiley & Sons) Introduction of Statistical Process Control.
4. BIS - Publication - Statistical Quality Control (Hand Book).
5. Mood A. M., Graybill F. A., Bose F. A. - Introduction to theory of Statistics (Third Edition).
6. Duncon A. J. - Quality control and Industrial Statistics.
7. Kelkar M. K. - Mathematical Methods (Narendra Prakashan, Pune).
8. A. R. Chandekar - Statistical Methods.
9. Meyer P. L. - Introductory Probability and Statistical Applications.
10. Kenney and Keeping - Mathematics of Statistics.
11. Gupta S. C. and Kapoor V. K. - Fundamental of Applied Statistics.
12. B. R. Bhat, T. Srivenkataramana Mahava Rao - Statistics (Vol - I and II) (New Age international Published).
13. Rao C.R. (1973); Linear Statistical inference and its Applications, Revised Edition, Wiley Eastern.
14. Rohatgi V.K. : (1986) : An Introduction to Probability Theory and Mathematical Statistics Wiley Eastern.
15. Hanagal David D. (2009). Introduction to Applied Statistics: A non-calculus based approach. Narosa Publishing House.

S.Y.B.Sc. (CBCS 2018 Course)
Semester – IV
S-43. : STATISTICS PRACTICAL COURSE –IV

Total Credit: 02

Course Learning Outcomes:

After completion of this course students will acquire:

1. Knowledge to solving the problems based on Chi-square test, Large Sample test.
2. Knowledge of solving the problems related to test based on t-distribution, F-distribution and construction of R-chart, fitting of multiple regression planes.
3. Knowledge of solving the problems using widely available software.

List of Practical

Sr. No.	Title of the Experiment
1	Test Based on Chi - square distribution. a) Test for independence of attributes. b) Goodness of fit. c) Test of variance.
2	Large sample tests for means and proportion.
3	Fisher's 'Z' transformation.
4	Confidence interval for means and proportions.
5	Tests based on t - distribution.
6	Tests based on F- distribution.
7	Construction of \bar{x} and R charts. (Standards are given).
8	Fitting of multiple regression planes.
9	Calculation of multiple correlation coefficient and partial correlation coefficient
10	Applications of CLT

S. Y. B. Sc.: (CBCS 2018 Course)
Semester – IV
ENG 41: English – II

Course Outcomes:

At the end of this course, a student shall be able to:

- get exposed to the prose passages, grammar units and communicative skills
- read and interpret the various types of texts on their own and discuss them among peers
- communicate effectively by developing their proficiency in language
- understand their language abilities and facilitate them to with the necessary online & offline resources

Course content:

60 Lectures

a) Text - *Pleasant Prose Selection* by Oxford University Press

- | | | |
|-----------------------------------|---|---------------------|
| 1. Half-A-Rupee Worth | - | R.K. Narayan |
| 2. The Last Leaf | - | O. Henry |
| 3. A Cup of Tea | - | Katherine Mansfield |
| 4. The Letter | - | Gaurishankar Joshi |
| 5. The Lady or the Tiger? Part I | - | Frank Stockton |
| 6. The Lady or the Tiger? Part II | - | Frank Stockton |

b) English Writing:

- | | |
|----------------------------|--------------------|
| 1. Curriculum Vitae | 2. E-mail Messages |
| 3. Informal Letter Writing | 4. Precis Writing |

c) Grammar:

- | | |
|----------|-----------|
| 1. Verbs | 2. Tenses |
|----------|-----------|

The books recommended:

1. Chettur G. K.: *English Grammar, Composition and Essay*.
2. M.L. Tickoo: *A Remedial Grammar, Usage and Grammar* (Orient Longman, 1976)
3. Thomson A.J. & Martinet A.V.: *Practical English Grammar* (OUP, 1986).
4. Tickoo C. & Shashikumar J.: *Writing With Purpose* (Oxford University Press, 1979).

S.Y.B.Sc. (CBCS 2018 Course)

Semester-IV

SEC42: MARATHI - II

अध्ययन निष्पत्ती :

१. मराठीतील विज्ञान साहित्याच्या प्रेरणा, उगम, वाटचाल आणि विकास जाणून घेण्यास मदत झाली.
२. वैज्ञानिक साक्षरता व वैज्ञानिक दृष्टिकोन विकसित झाला.
३. विज्ञानाचा प्रसार स्वभाषेतून करण्यासाठी आवश्यक ती भाषिक क्षमता वाढीस लागली.
४. मराठीतील विज्ञान कथांचा स्थूल स्वरूपात परिचय झाला.

Total Credit :- 04

तासिका - ६०

घटक-विश्लेषण :

१. संकरित (विज्ञानकथासंग्रह) - डॉ. संजय ढोले, मेहता पब्लिशिंग हाऊस, पुणे
(१) अस्तित्व (२) उद्ध्वस्त (३) अखेर तो परतला (४) सॉकर (५) विचारवहन (६) दुर्गम्य
२. वैज्ञानिक परिभाषानिर्मितीची आवश्यकता, वैज्ञानिक परिभाषेचे स्वरूप व विशेष
३. प्रसारमाध्यमांसाठी लेखन
मुद्रित माध्यम, आकाशवाणी व दूरदर्शन
विविध आकृतिबंधांची ओळख - भाषण, लेख, संवाद, चर्चा व रूपक

संदर्भ - साहित्य

१. विज्ञान : उदय व विकास-डॉ. प्र. न. जोशी, सन पब्लिकेशन्स, पुणे
२. श्रद्धा-अंधश्रद्धा-डॉ. नरेंद्र दाभोळकर, राजहंस प्रकाशन, पुणे
३. भ्रमनिरास-डॉ. नरेंद्र दाभोळकर, राजहंस प्रकाशन, पुणे
४. व्यावहारिक मराठी (द्वितीय वर्ष विज्ञान)-पुणे विद्यापीठ प्रकाशन
५. मराठी विज्ञान साहित्य- संपा. म. सु. पगारे, प्रशांत प्रकाशन, पुणे
६. विज्ञान कथा : स्वरूप आणि समीक्षा - श्री. विश्वेश्वर सावदेकर, शलाका प्रकाशन, मुंबई
७. विज्ञान साहित्य आणि संकल्पना- व. दि. कुलकर्णी, निरंजन घाटे, निहारा प्रकाशन, पुणे
८. विज्ञान युग- वार्षिक दिवाळी अंक १९८६, विज्ञान कथा विशेषांक
९. विज्ञान कथा विशेषांक,- महाराष्ट्र साहित्य पत्रिका, ऑक्टोबर-डिसेंबर २००६.
१०. विज्ञान वेध- मोहन आपटे, राजहंस प्रकाशन, पुणे
११. वैज्ञानिक दृष्टीकोण आणि आपण- सुधीर पानसे, लोकवाङ्मय गृह, मुंबई
१२. विज्ञान साहित्यविश्व- निरंजन घाटे, अभिनुजा प्रकाशन, पुणे

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