

**DEPARTMENT OF ENGLISH  
KAKATIYA UNIVERSITY  
SYLLABUS FOR I YEAR (I SEMESTER) GENERAL ENGLISH  
AT UNDERGRADUATE LEVEL  
w.e.f (under CBCS from 2019-2020)**

**Text Book Entitled - *English for Advancement* for I Year (Sem I & II) 4 Credits**  
Published by Orient BlackSwan

<b>UNIT ONE (SHORT FICTION)</b>	<b>TEXT</b>	<b>AN ASTROLOGER'S DAY by R.K.NARAYAN</b>
	GRAMMAR	NOUNS AND PRONOUNS
	VOCABULARY	WORD ROOTS
	READING COMPREHENSION	HAZARDS OF FOOD COLOURING
	PRONUNCIATION	CONSONANTAL SOUNDS
	LANGUAGE SKILLS	TYPES OF LISTENING
	SOFT SKILLS	MOTIVATION AND GOAL-SETTING
<b>UNIT TWO (PROSE)</b>	<b>TEXT</b>	<b>OF STUDIES by FRANCIS BACON</b>
	GRAMMAR	ADJECTIVES
	VOCABULARY	FUNNY SIDE OF ENGLISH
	READING COMPREHENSION	PLEASURES OF IGNORANCE by ROBERT LYND
	PRONUNCIATION	VOWEL SOUNDS
	LANGUAGE SKILLS	CONVERSATION SKILLS
	SOFT SKILLS	TIME MANAGEMENT
<b>UNIT THREE (POETRY)</b>	<b>TEXT</b>	<b>A POISON TREE by WILLIAM BLAKE</b>
	GRAMMAR	ADVERBS
	SPELLING	COMMONLY MISPELT WORDS

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	READING COMPREHENSION	VALUES IN LIFE by RUDYARD KIPLING
	PRONUNCIATION	PHONETIC TRANSCRIPTION
	SOFT SKILLS	EMOTIONAL INTELLIGENCE & SOCIAL CONSCIOUSNESS
<b>UNIT FOUR (DRAMA)</b>	<b>TEXT</b>	<b>THE RISING OF THE MOON by LADY GREGORY</b>
	GRAMMAR	VERBS
	PRONUNCIATION	INTONATION
	READING COMPREHENSION	HAZRATH URS
	LANGUAGE SKILLS	SPEAKING : JAM
	VALUE ORIENTATION	SELF-DISCOVERY

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**DEPARTMENT OF ENGLISH  
KAKATIYA UNIVERSITY  
SYLLABUS FOR I YEAR (II SEMESTER) GENERAL ENGLISH  
AT UNDERGRADUATE LEVEL  
(under CBCS from 2019-2020)**

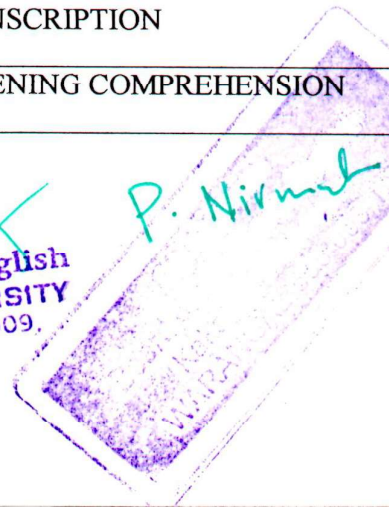
<b>UNIT ONE (SHORT FICTION)</b>	<b>TEXT</b>	<b>WITH THE PHOTOGRAPHER by STEPHEN LEACOCK</b>
	GRAMMAR	PREPOSITIONS
	VOCABULARY	PREFIXES AND SUFFIXES
	READING COMPREHENSION	SPORTS, POLITICS AND DEMOCRACY by ARIO BIMO UTOMO
	PRONUNCIATION	STRESS
	LANGUAGE SKILLS	INTRODUCING ONSELF IN FORMAL AND INFORMAL SITUATIONS
	SOFT SKILLS	LATERAL THINKING
<b>UNIT TWO (PROSE)</b>	<b>TEXT</b>	<b>A TREATISE ON GOOD MANNER AND GOOD BREEDING by JONATHAN SWIFT</b>
	GRAMMAR	CONJUNCTIONS
	VOCABULARY	SYNONYMS
	READING COMPREHENSION	THE ECONOMIC POWER OF LANGUAGE by GABRIELLE HOGAN-BRUN
	PRONUNCIATION	STRESS AND PRACTICE IN PHONETIC TRANSCRIPTION
	LANGUAGE SKILLS	LISTENING COMPREHENSION

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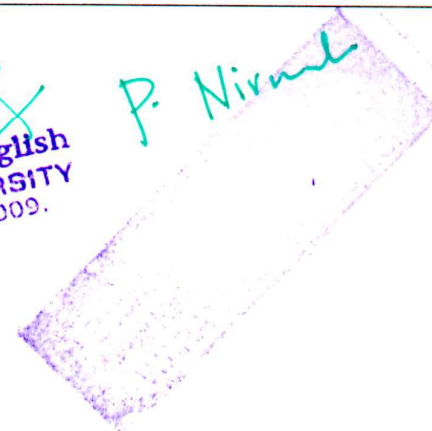
	SOFT SKILLS	ATTITUDE
<b>UNIT THREE (POETRY)</b>	<b>TEXT</b>	<b>ODE ON SOLITUDE by ALEXANDER POPE</b>
	GRAMMAR	KINDS OF SENTENCE
	SPELLING	PLURALS
	READING COMPREHENSION	JADAV PAYENG: THE FOREST MAN OF INDIA
	PRONUNCIATION	ASSIMILATION
	SOFT SKILLS	TEAM WORK
<b>UNIT FOUR (DRAMA)</b>	<b>TEXT</b>	<b>A MARRIAGE PROPOSAL by ANTON CHEKOV</b>
	GRAMMAR	COMMON MISTAKES
	PRONUNCIATION	ELISON
	READING COMPREHENSION	HOW I BECAME A PUBLIC SPEAKER? by GEORGE BERNARD SHAW
	LANGUAGE SKILLS	PRESENTATIONS
	VALUE ORIENTATION	SELF-CONFIDENCE

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
Under Graduate Courses (Under CBCS 2020 – 2021 onwards)  
**B.A/B.COM/BBA/B.SC ENGLISH II YEAR**  
**SEMESTER – III**

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**PAPER – III: ENGLISH**

Theory:                      3 Hours/Week;                      Credits: 3                      Marks: 100 (Internal: 20; External: 80)

**Prescribed Textbook entitled: English for Excellence**

**Published by Orient BlackSwan**

**UNIT I: GENDER EQUALITY**

1. “Achieving Gender Equality in India: What Works, and What Doesn’t” by Smriti Sharma
2. “They Shut me up in Prose” by Emily Dickinson
3. Prepositions
4. Phrasal Verbs

**UNIT II: GENDER ROLES**

1. “The Wonder Story of Kalpana Saroj” by Rakhi Chakraborty
2. “The Kitchen” by Vimala
3. Voice
4. Technical Vocabulary

**UNIT III: ENDING VIOLENCE AGAINST WOMEN**

1. “What is my Name?” by P.Sathyavathi
2. “Voice of the Unwanted Girl” by Sujatha Bhatt
3. Connectives
4. Idioms



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**B.A/B.COM/BBA/B.SC ENGLISH II YEAR**  
**SEMESTER – IV**

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**PAPER – IV: ENGLISH**

**Theory:                    3 Hours/Week;                    Credits: 3                    Marks: 100 (Internal: 20; External: 80)**

**Prescribed Textbook entitled: English for Excellence**  
**Published by Orient BlackSwan**

**UNIT I: RENEWABLE AND NON-RENEWABLE RESOURCES**

1. Jadav Payeng
2. “The Tame Bird was in a Cage” by Rabindranath Tagore
3. Reported Speech
4. Commonly Confused Words

**UNIT II: ECOSYSTEMS AND ENVIRONMENTAL POLLUTION**

1. “Climate Change and Global Warming” by Michael Shafer
2. “A Requiem for Earth” by O.N.V.Kurup
3. Conditionals
4. Suffixes

**UNIT III: CONSERVATION AND BIODIVERSITY**

1. “The Ungrateful Man: A Conversation between Trees ” by Swathi Shenoy
2. “The Felling of the Banyan Tree” by Dilip Chitre
3. Common Errors
4. Collocations



C.B.C.S Pattern Syllabus from 2019-2010 onwards  
B.A., B.Sc., B.Com. & B.B.A.  
2nd Semester IInd Languages - Telugu

Unit -I ప్రాచీన కవిత్వం

- 1) గజేంద్ర మోక్షం-పోతన
- 2) హనుమత్ సందేశం-మొల్ల
- 3) సుభాషితాలు-ఎనుగు లక్ష్మణ కవి

Unit -II ఆధునిక కవిత్వం

- 1) స్నేహలత లేఖ-రాయప్రోలు సుబ్బారావు
- 2) అంతర్నాదం-దాశరథి కృష్ణమాచార్యులు
- 3) ప్రపంచపదులు-డా॥ సి.నారాయణరెడ్డి
- 4) అల్విదా-కౌముది

Unit -III వచన విభాగం

- 1) యుగాంతం-నెల్లూరి కేశవ స్వామి
- 2) ఎంకన్న - ఆచార్య పాకాల యశోదారెడ్డి
- 3) మామిడి పండు - సురవరం ప్రతాపరెడ్డి
- 4) మా ఊరుపోయింది-దేవులపల్లి వేంకట కృష్ణశాస్త్రి

Unit -IV ఛందస్సు

ఉత్పలమాల, చంపకమాల, శార్దూలం, మత్తేభం, ఆటవెలది, తేటగీతి, ద్విపద, సీసం, కందం, ఉత్సాహం, తరళం, స్రగ్ధర, మహాస్రగ్ధర, ముత్యాలసరం





KAKATIYA UNIVERSITY, WARANGAL  
B.A., B.Sc., B.Com. & B.B.A (CBCS)  
Syllabus - 2020  
Telugu (Second Language)  
3rd Semester

Unit -I ప్రాచీన పద్యభాగం

- 1) ధర్మజుని వాక్యాతుర్యం - తిక్కన
- 2) విభీషణ శరణాగతి - గోన బుద్ధారాజు
- 3) గుణనిధి కథ - శ్రీనాథుడు

Unit -II ఆధునిక పద్యభాగం

- 1) లైతు ప్రశస్తి - వానమామలై జగన్నాథాచార్యులు
- 2) గురుదక్షిణ - అంబటి లక్ష్మీనరసింహారాజు
- 3) గుడిసెలు కాలిపోతున్నై - డా॥ బోయి భీమన్న

Unit -III అలంకారాలు

- శబ్దాలంకారాలు: వృత్త్యనుప్రాస, ఛేకానుప్రాస, లాటానుప్రాస,  
అంత్యానుప్రాస, యమకం, ముక్తపదగ్రస్తాలంకారాలు
- అర్థాలంకారాలు: ఉపమ, ఉత్పేక్ష, రూపక, స్వభావోక్తి, ఉల్లేఖ,  
అర్థాంతరవ్యాస, జ్ఞేష, దృష్టాంతాలంకారాలు

పాఠ్యగ్రంథం: తెలుగు అకాడమీ వారి "సాహితీ కిన్నెర" తెలుగు వాచకం

  
29.8.2020  
Chairman  
Board of Studies in Telugu  
KAKATIYA UNIVERSITY  
WARANGAL, P.



  
Head  
Department of Telugu  
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Warangal-506 003(T.S.).

KAKATIYA UNIVERSITY, WARANGAL  
B.A., B.Sc., B.Com. & B.B.A (CBCS)  
Syllabus - 2020  
Telugu (Second Language)  
4th Semester

Unit -I ప్రాచీన పద్యభాగం

- 1) నారద గానమాతృర్యం - పింగలి సూరన
- 2) వాగ్దాన భంగం - అసూరి మరింగంటి వేంకట నరసింహాచార్యులు
- 3) నారసింహ శతకం - ధర్మపురి శేషప్ప

Unit -II ఆధునిక పద్యభాగం

- 1) నరుడ నేను, నరుడ నేను - కాళోజీ
- 2) ఆత్మగీతం - దేవరకొండ బాలగంగాధర తిలక్
- 3) దేవరకొండ దుర్గం - డా॥ ముకురాల రామారెడ్డి

Unit -III వచన విభాగం

- 1) అర్ధరాత్రి అరుణోదయం - దాశరథి రంగాచార్య
- 2) సి.పి బ్రౌన్ సాహిత్య సేవ - జానమద్ది హనుమచ్ఛాస్త్రి
- 3) మన గ్రామ నామాలు - డా॥ కపిలవాయి లింగమూర్తి
- 4) నివురు తొలగిన నిప్పు - పోల్కంపల్లి శాంతాదేవి
- 5) కొండమల్లెలు - ఇల్లిందల సరస్వతీదేవి

పాఠ్యగ్రంథం: తెలుగు అకాడమీ వారి "సాహితీ కిన్నెర" తెలుగు వాచకం

  
29.8.2020  
Chairman  
Board of Studies in Telugu  
KAKATIYA UNIVERSITY  
WARANGAL, A.P.



  
Head  
Department of Telugu  
Kakatiya University  
Warangal-506 09(T.S.).

**KAKATIYA UNIVERSITY, WARANGAL**  
**B.Sc. Programme**  
**Under CBCS System wef A.Y: 2020-21**  
**Second Year :: Semester - IV**  
**BS-402/ SEC-4 (Common to all Science Courses)**

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**Remedial Methods of Pollution - Drinking Water & Soil Fertility**

[ 2HPW, #Credits: 2, Marks:50 (Internal:10, External:40)]

(Taught by: Chemistry Department)

**UNIT I: Remedial Methods for Pollution:**

Prevention and control of air pollution: Ozone hole - Causes and harm due to ozone depletion, Effect of CFC's in Ozone depletion and their replacements, Global Warming and Green-house effect, Precaution measures to control global warming, Deleterious effect of pollutants, Endangered monuments, Acid rain, Precautions to protect monuments, Sources of Radiation pollution, Chernobyl accident and its consequences. Radiation effect by usage of cell phones and protection tips, Deleterious effects of cell phone towers and health hazards.

Sources of water pollution: (i) Pollution due to pesticides and inorganic chemicals, (ii) Thermal pollution (iii) Ground water pollution (iv) Eutrophication.

Methods for control of water pollution and water recycling: Dumping of plastics in rivers and oceans and their effect on aquatic life, Determination of (i) Dissolved oxygen and (ii) Chemical Oxygen demand in polluted water, Illustration through charts (or) demonstration of experiments,

Sources of soil pollution: (i) Plastic bags (ii) Industrial and (iii) Agricultural sources, Control of soil pollution, Environmental laws in India, Environmental benefits of planting trees.

**UNIT II: Drinking Water and Soil Fertility Standards and Analysis:**

Water quality and common treatments for private drinking water systems, Drinking Water Standards: 1. Primary drinking water standards: Inorganics, Organics and Volatile Organic Chemicals, 2. Secondary drinking water standards: Inorganics and Physical Problems, Water testing, Mineral analysis, Microbiological tests, Pesticide and Other Organic Chemical Tests, Principle involved in Water Treatment Techniques: (i) Reverse Osmosis (ii) Disinfection methods such as Chlorination, Ultraviolet light, ozonation etc... (iii) Chemical oxidation and iv) Ion exchange (water softeners). Visit to nearby drinking water plants and interaction at sites.

Introduction to Soil Chemistry: Basic Concepts. Effect of  $P^H$  on nutrient availability, Macronutrients and their effect on plants, Carbon, Hydrogen, Oxygen, Nitrogen and Phosphorus, other macronutrients, Calcium, Magnesium and Sulfur, Micronutrients and their effect on plants, Boron ( $B_4O_7^{2-}$ ), Copper ( $Cu^{2+}$ ), Iron ( $Fe^{2+}$ ,  $Fe^{3+}$ ), Manganese ( $Mn^{2+}$ ), Molybdenum ( $MoO_4^{2-}$ ), Zinc ( $Zn^{2+}$ ), Cobalt ( $Co^{2+}$ ), Chlorine ( $Cl^-$ ) and others. Determination of soil nitrogen by Kjeldahl method, Illustration through charts and demonstration of experiment, Visit to nearby agricultural farms and interaction with farmers, Discussion with farmers on the use of 'Soil Analysis Kits'.

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**

**B.Sc. Programme under CBCS**

With effect from the A.Y: 2019

**Optional Paper**

**(Common to all Science Courses)**

**III Year SEMESTER – VI**

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**PUBLIC HEALTH AND HYGIENE**

**UNIT-I: Nutrition, Environment and Health**

- 1.1 Classification of foods – Carbohydrates, Proteins, Lipids and Minerals.
- 1.2 Nutritional deficiencies and disorders of Carbohydrates, Proteins, Lipids and Minerals.
- 1.3 Concept, Steps and Applications of Environment and Health Impact Assessment.
- 1.4 Industrial, Agricultural and Urban Health. Environmental Pollution and Associated Health Hazards.

**UNIT-II : Communicable and Non-Communicable Diseases**

- 2.1 Causes, symptoms, diagnosis, treatment and prevention of Communicable Diseases (Malaria, Filaria, Tuberculosis and AIDS).
- 2.2 Causes, symptoms, diagnosis, treatment and prevention of Non-Communicable Diseases (Hypertension, Coronary Heart Diseases, Diabetes and Obesity).
- 2.3 Symptoms, treatment and prevention measures of Water Borne Diseases (Diarrhea, Typhoid, Hepatitis and Amebiasis).
- 2.4 Symptoms, treatment and prevention measures Air Borne Diseases (COVID-19, Influenza, Whooping cough and Chickenpox).

**UNIT-III :Food and Diet Systems**

- 3.1 Definition of Food, Types of foods (Texturized foods, Novel foods and Organic foods).
- 3.2 Food safety system and issues; Physical, chemical and microbiological contaminants; The significance of foodborne diseases.
- 3.3 Principles of diet in diseases, Classification of diets according to nutrients.
- 3.4 Etiology, Symptom and Dietary Management in Obesity, Underweight, Hypertension, Diabetes Mellitus, Atherosclerosis.

**UNIT-IV : Personal Hygiene and Sanitation**

- 4.1 Definition of Hygiene and Sanitation, Personal Hygiene of food handler, Techniques of Washing Hands, Pest control and Garbage Disposal.
- 4.2 Definition of Public Health, Hygiene, Social and Preventive Medicine, Basic aspects of Personal Hygiene and Disposal of Waste.
- 4.3 The Hygiene Practices of the different categories of family members (children, parents and aged members)
- 4.4 Definition of Sanitation, Environmental Sanitation, Sanitation of Food Serving Institution, The importance of proper sanitation practices.

**Suggested Readings:**

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**B.Sc., BOTANY**  
**First Year, I -Semester**  
**Paper-I**  
**Microbial Diversity and Lower Plants**

**DSC - 1A (4 hrs./week)**

**Credits- 4**

**Theory Syllabus**

**(60 hours)**

**UNIT - I**

**(15 hours)**

- 1) **Bacteria:** Structure, nutrition, reproduction and economic importance. Brief account of Archaeobacteria, Actinomycetes and Mycoplasma with reference to little leaf of Brinjal and Papaya leaf curl
- 2) **Viruses:** Structure, replication and transmission; plant diseases caused by viruses and their control with reference to Tobacco Mosaic and Rice Tungro.
- 3) An outline of plant diseases of important crop plants caused by bacteria and their control with reference to Angular leaf spot of cotton and Bacterial blight of Rice.

**UNIT-II**

**(15 hours)**

- 1) General characters, structure, reproduction and classification of algae (Fritsch)
- 2) **Cyanobacteria:** General characters, cell structure their significance as biofertilizers with special reference to Oscillatoria, Nostoc and Anabaena.
- 3) Structure and reproduction of the following:  
Chlorophyceae- Volvox, Oedogonium and Chara.  
Phaeophyceae- Ectocarpus  
Rhodophyceae- Polysiphonia.

**UNIT-III**

**(15 hours )**

- 1) General characters and classification of fungi (Ainsworth).
- 2) Structure and reproduction of the following:  
(a) Mastigomycotina- Albugo  
(b) Zygomycotina- Mucor  
(c) Ascomycotina- Saccharomyces and Penicillium.  
(d) Basidiomycotina- Puccinia  
(e) Deuteromycotina- Cercospora.
- 3) Economic importance of lichens

**UNIT-IV**

**(15 hours )**

- 1) **Bryophytes:** Structure, reproduction, life cycle and systematic position of Marchantia, Anthoceros and Polytrichum, Evolution of Sporophyte in Bryophytes.
- 2) **Pteridophytes:** Structure, reproduction, life cycle and systematic position of Rhynia, Lycopodium, Equisetum and Marsilea.
- 3) Stelar evolution, heterospory and seed habit in Pteridophytes.

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*Shelva* *Abhishek* *Almita* *BSR* *RPD*  
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## References:

- 1) Alexopolous, J. and W. M. Charles. 1988. *Introduction to Mycology*. Wiley Eastern, New Delhi.
- 2) Mckane, L. and K. Judy. 1996. *Microbiology – Essentials and Applications*. McGraw Hill, New York.
- 3) Pandey, B. P. 2001. *College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta*. S. Chand & Company Ltd, New Delhi.
- 4) Pandey, B. P. 2007. *Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics*. S. Chand & Company Ltd, New Delhi.
- 5) Sambamurthy, A. V. S. S. 2006. *A Textbook of Plant Pathology*. I. K. International Pvt. Ltd., New Delhi.
- 6) Sambamurthy, A. V. S. S. 2006. *A Textbook of Algae*. I. K. International Pvt. Ltd., New Delhi.
- 7) Sharma, O. P. 1992. *Textbook of Thallophtya*. McGraw Hill Publishing Co., New Delhi.
- 8) Thakur, A. K. and S. K. Bassi. 2008. *A Textbook of Botany: Diversity of Microbes and Cryptogams*. S. Chand & Company Ltd, New Delhi.
- 9) Vashishta, B. R., A. K. Sinha and V. P. Singh. 2008. *Botany for Degree Students: Algae*. S. Chand & Company Ltd, New Delhi.
- 10) Vashishta, B. R. 1990. *Botany for Degree Students: Fungi*, S. Chand & Company Ltd, New Delhi.
- 11) Dutta A.C. 2016. *Botany for Degree Students*. Oxford University Press.
- 12) Watson, E. V. 1974. *The structure and life of Bryophytes*, B. I. Publications, New Delhi.
- 13) Pandey, B. P. 2006. *College Botany, Vol. II: Pteridophyta, Gymnosperms and Palcobotany*. S. Chand & Company Ltd, New Delhi.
- 14) Vashishta, P. C., A. K. Sinha and Anil Kumar. 2006. *Botany - Pteridophyta (Vascular Cryptogams)*. . Chand & Company Ltd, New Delhi.
- 15) Pandey, B. P. 2001. *College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta*. S. Chand & Company Ltd, New Delhi.
- 16) Pandey, B. P. 2007. *Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics*. S. Chand & Company Ltd, New Delhi.
- 17) Thakur, A. K. and S. K. Bassi. 2008. *A Textbook of Botany: Diversity of Microbes and Cryptogams*. S. Chand & Company Ltd, New Delhi.
- 18) Vashishta, B. R., A. K. Sinha and Adarsha Kumar. 2008. *Botany for Degree Students: Bryophyta*. S. Chand & Company Ltd, New Delhi.

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1. Study of viruses and bacteria using electron micrographs (photographs).
2. Gram staining of Bacteria.
3. Study of symptoms of plant diseases caused by viruses, bacteria, Mycoplasma and fungi:  
 Viruses: Tobacco mosaic  
 Bacteria: Angular leaf spot of cotton and Rice tungro.  
 Mycoplasma: Little leaf of Brinjal and Leaf curl of papaya  
 Fungi: White rust on Crucifers, Rust on wheat & Tikka disease of Groundnut.
4. Vegetative and reproductive structures of the following taxa:  
 Algae: Oscillatoria, Nostoc, Volvox, Oedogonium, Chara, Ectocarpus and Polysiphonia.  
 Fungi: Albugo, Mucor, Saccharomyces, Penicillium, Puccinia and Cercospora
5. Section cutting of diseased material infected by Fungi and identification of pathogens as per theory syllabus. White rust of Crucifers, Rust on wheat & Tikka disease of Groundnut.
6. Lichens: Different types of thalli and their external morphology
7. Examination of important microbial, fungal and algal products:  
 Biofertilizers, protein capsules, antibiotics, mushrooms, Agar-agar etc.
8. Field visits to places of algal / microbial / fungal interest (e.g. Mushroom cultivation, water bodies).
9. Study of Morphology (vegetative and reproductive structures) and anatomy of the following  
 Bryophytes: Marchantia, Anthoceros and Polytrichum.
10. Study of Morphology (vegetative and reproductive structures) and anatomy of the following  
 Pteridophytes: Lycopodium, Equisetum and Marsilea.
11. Study of Anatomical features of Lycopodium stem, Equisetum stem and Marsilea petiole & rhizome by preparing double stained permanent mounts.

**Practical Model Paper**

**Max. Marks: 25**

**Time : 3 hrs**

1. Identify the given components 'A' & 'B' in the algal mixture .  
 Describe with neat labeled diagrams & give reasons for the classifications. 2 X 2 = 4M
2. Classify the given bacterial culture 'D' using Gram – staining technique. 3M
3. Take a thin transverse section of given diseased material 'E'.  
 Identify & describe the symptoms caused by the pathogen. 4M
4. Identify the given specimens 'F', 'G' & 'H' by giving reasons .  
 (Fungal-1, Bacteria-1 & Viral-1) 3 X 1 = 3M
5. Comment on the given slides 'I' & 'J' (Algae-1, Fungi-1) 2 X 2 = 4M
6. Identify the given specimen 'K' & slide 'L' (Bryophytes & Pteridophytes) 2 X 2 = 4M
7. Record 3M


  
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# B.Sc., BOTANY

## First Year, II -Semester

### Paper-II

### Gymnosperms, Taxonomy of Angiosperms and Ecology

DSC-1B

Credits-4

#### Theory Syllabus

#### UNIT-I

- 1) Gymnosperms: General characters, structure, reproduction and classification (Sporne's). Distribution and economic importance of Gymnosperms.
- 2) Morphology of vegetative and reproductive parts, systematic position and life cycle of Pinus and Gnetum,
- 3) Geological time scale Introduction to Palaeobotany, Types of fossils and fossilization, Importance of fossils.

#### UNIT-II

(15 hours )

- 1) Introduction: Principles of plant systematics, Types of classification: Artificial, Natural and Phylogenetic; Systems of classification: Salient features and comparative account of Bentham & Hooker and Engler & Prantl classification systems. An introduction to Angiosperm Phylogeny Group (APG).
- 2) Current concepts in Angiosperm Taxonomy: Embryology in relation to taxonomy Cytotaxonomy, Chemotaxonomy and Numerical Taxonomy.
- 3) Nomenclature and Taxonomic resources: An introduction to ICN, Shenzhen code – a brief account. Herbarium: Concept, techniques and applications.

(15 hours )

#### UNIT-III

- 1) Systematic study and economic importance of plants belonging to the following families: Polypetalae Annonaceae, Capparidaceae, Rutaceae, Fabaceae (Faboideae/Papilionoideae, Caesalpinioideae, Mimosoideae), Cucurbitaceae
- 2) Gamopetalae: Apiaceae, Asteraceae, Asclepiadaceae, Lamiaceae, Monochalmydeae: Amaranthaceae, Euphorbiaceae
- 3) Monocotyledons: Orchidaceae, Poaceae and Zingiberaceae.

#### UNIT-IV

(15 hours )

1. Component of eco system, energy flow, food chain and food webs.
2. Plants and environment, ecological adaptations of plants, Hydrophytes, Xerophytes and Mesophytes
3. Plant Succession serial stages, modification of environment, climax formation with reference to Hydrosere and Xerosere.

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Shelley A. Kumar



Practical Syllabus

(45 hours)

1. Study of viruses and bacteria using electron micrographs (photographs).
2. Gram staining of Bacteria.
3. Study of symptoms of plant diseases caused by viruses, bacteria, Mycoplasma and fungi:  
Viruses: Tobacco mosaic  
Bacteria: Angular leaf spot of cotton and Rice tungro.  
Mycoplasma: Little leaf of Brinjal and Leaf curl of papaya  
Fungi: White rust on Crucifers, Rust on wheat & Tikka disease of Groundnut.
4. Vegetative and reproductive structures of the following taxa:  
Algae: Oscillatoria, Nostoc, Volvox, Oedogonium, Chara, Ectocarpus and Polysiphonia.  
Fungi: Albugo, Mucor, Saccharomyces, Penicillium, Puccinia and Cercospora
5. Section cutting of diseased material infected by Fungi and identification of pathogens as per theory syllabus. White rust of Crucifers, Rust on wheat & Tikka disease of Groundnut.
6. Lichens: Different types of thalli and their external morphology
7. Examination of important microbial, fungal and algal products:  
Biofertilizers, protein capsules, antibiotics, mushrooms, Agar-agar etc.
8. Field visits to places of algal / microbial / fungal interest (e.g. Mushroom cultivation, water bodies).
9. Study of Morphology (vegetative and reproductive structures) and anatomy of the following Bryophytes: Marchantia, Anthoceros and Polytrichum.
10. Study of Morphology (vegetative and reproductive structures) and anatomy of the following Pteridophytes: Lycopodium, Equisetum and Marsilea.
11. Study of Anatomical features of Lycopodium stem, Equisetum stem and Marsilea petiole & rhizome by preparing double stained permanent mounts.

Practical Model Paper

Max. Marks: 25

Time : 3 hrs

1. Identify the given components 'A' & 'B' in the algal mixture .  
Describe with neat labeled diagrams & give reasons for the classifications. 2 X 2 = 4M
2. Classify the given bacterial culture 'D' using Gram – staining technique. 3M
3. Take a thin transverse section of given diseased material 'E' .  
Identify & describe the symptoms caused by the pathogen. 4M
4. Identify the given specimens 'F', 'G' & 'H' by giving reasons .  
(Fungal-1, Bacteria-1 & Viral-1) 3 X 1 = 3M
5. Comment on the given slides 'I' & 'J' (Algae-1, Fungi-1) 2 X 2 = 4M
6. Identify the given specimen 'K' & slide 'L' (Bryophytes & Pteridophytes ) 2 X 2 = 4M
7. Record 3M

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### References:

1. Watson, E. V. 1974. The structure and life of Bryophytes, B. I. Publications, New Delhi.
2. Pandey, B. P. 2006. College Botany, Vol. II: Pteridophyta, Gymnosperms and Paleobotany. S. Chand & Company Ltd, New Delhi.
3. Sporne, K. R. 1965. Morphology of Gymnosperms. Hutchinson Co., Ltd., London.
4. Vashishta, P. C., A. K. Sinha and Anil Kumar. 2006. Botany - Pteridophyta (Vascular Cryptogams). . Chand & Company Ltd, New Delhi.
5. Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
6. Pandey, B. P. 2007. Botany for Degree Students: Diversity of Microbes, Cryptogams, Cell Biology and Genetics. S. Chand & Company Ltd, New Delhi.
7. Thakur, A. K. and S. K. Bassi. 2008. A Textbook of Botany: Diversity of Microbes and Cryptogams. S. Chand & Company Ltd, New Delhi.
8. Vashishta, B. R., A. K. Sinha and Adarsha Kumar. 2008. Botany for Degree Students: Bryophyta. S. Chand & Company Ltd, New Delhi.
9. Vashishta, P. C., A. K. Sinha and Anil Kumar. 2006. Botany for Degree Students: Gymnosperms. Chand & Company Ltd, New Delhi.
10. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
11. Pandey, B. P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi
12. Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.). Edward Arnold, London.
13. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
14. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
15. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
16. Heywood, V. H. 1965 . Plant Taxonomy. ELBS , London.
17. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
18. Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge. London.
19. Michael, S. 1996, Ecology, Oxford University Press, London
20. Odum, E.P. 1983. Basics of Ecology, Saunder's International Students Edition, Philadelphia.
21. Sharma P.D. 1989. Elements of Ecology, Rastogi Publications, Meerut

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**Practical Syllabus**

**(45 hours)**

1. Study of Morphology (vegetative and reproductive structures) of the following taxa:  
Gymnosperms - Pinus and Gnetum.
2. Study of Anatomical features of Pinus needle and Gnetum stem by preparing double stained permanent mounts.
3. Fossil forms using permanent slides / photographs: Cycadeoidea.  
Systematic study of locally available plants belonging to the families prescribed in theory Syllabus (Minimum of one plant representative for each family)
4. Study of morphological and anatomical characteristics of locally available plant species (Eichhorinia, Hydrilla, Pistia, Nymphaea, Asparagus, Opuntia, Euphorbia melii)
5. Demonstration of herbarium techniques.
6. Candidate has to submit at least 30 herbarium sheets.

**Practical Model Paper**

**Time : 3 hrs**

**Max. Marks: 50**

1. Prepare a mount of the given material ' A ' (Hydrophytes /Xerophytes)  
Draw diagram & give reasons for identification. 8M
2. Prepare a double stained permanent mount of the given material ' B ' ( Gymnosperms )  
Draw diagram & give reasons for identification. 10M
3. Identify the given specimens C & D (Gymnosperms /Xerophytes) 2 X 4 = 8M
4. Identify the given slides E&F (Gymnosperms /Xerophytes) 2 X 4 = 8M
5. Technical description of the given plant twig ' A '  
10M
6. Herbarium 3M
7. Record 3M

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
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**B.Sc. BOTANY II Year**  
**SEMESTER – III**

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**PLANT ANATOMY AND EMBRYOLOGY**

<b>Theory:</b>	<b>4 Hours/Week;</b>	<b>Credits: 4</b>	<b>Marks: 100 (Internal: 20; External: 80)</b>
<b>Practical:</b>	<b>3 Hours/Week</b>	<b>Credits: 1</b>	<b>Marks: 25</b>

**UNIT – I**

Meristems: Types, histological organization of shoot and root apices and theories.

1. Tissues and Tissue Systems: Simple, complex and special tissues.
2. Leaf: Ontogeny, diversity of internal structure; stomata and epidermal outgrowths.

**UNIT –II**

4. Stem and root anatomy: Vascular cambium - Formation and function.
5. Anomalous secondary growth of Stem -*Achyranthes*, *Boerhaavia*, *Bignonia*, *Dracaena*; Root— *Beta vulgaris*.
6. Wood structure: General account. Study of local timbers — Teak (*Tectona grandis*), Rosewood, (*Dalbergia latefolia*), Red sanders, (*Pterocarpus santalinus*) Nallamaddi (*Terminalia tomentosa*) and Neem (*Azadirachta indica*).

**UNIT-III**

7. History and importance of Embryology.
8. Another structure, Microsporogenesis and development of male gametophyte.
9. Ovule structure and types; Megasporogenesis; types and development of female gametophyte.

**UNIT- IV**

10. Pollen morphology, pollination and fertilization, Pollination Types, Pollen - pistil interaction, Double fertilization.
11. Seed - structure appendages and dispersal mechanisms.
12. Endosperm - Development and types. Embryo - development and types; Polyembryony and Apomixis -- an outline.

**References:**

1. Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
2. Bhojwani, S. S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House, Delhi.
3. M.R.Saxena- A textbook of Palynology.
4. Vashista- A textbook of Anatomy.
5. P.K.K.Nair- A textbook of Palynology.
6. Esau, K. 1971. Anatomy of Seed Plants. John Wiley and Son, USA.
7. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verleg, Berlin.
8. Kapil, R. P. 1986. Pollination Biology. Inter India Publishers, New Delhi.
9. Maheswari, P. 1971. An Introduction to Embryology of Angiosperms. McGraw Hill Book Co., London.
10. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press

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**SEMESTER – III**

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**PLANT ANATOMY AND EMBRYOLOGY**  
**PRACTICAL**

1. Demonstration of double stain technique.
2. Preparation of double stained Permanent slides  
Primary structure: Root - *Cicer, Canna*; Stem — *Tridax, Sorghum*  
Secondary structure: Root — *Tridax* sp.; Stem — *Pongarnia*  
Anomalous secondary structure:  
Stem: *Achyranthes, Boerhavia, Bignonia, Dracaena*  
Root: *Beta vulgaris*
3. Stomatal types using epidermal peels (Dicots).
4. Structure of anther and microsporogenesis using permanent slides.
5. Structure of pollen grains using whole mounts - *Hibiscus, Acacia* and Grass).
6. Pollen viability test using Evans Blue — *Hibiscus*
7. Study of ovule types and developmental stages of embryo sac.
8. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot embryos using permanent slides.
9. Isolation and mounting of embryo (using *Cymopsis / Senna / Crotalaria*)

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**SEMESTER – IV**

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## CELL BIOLOGY AND PLANT PHYSIOLOGY

**Theory: 4 Hours/Week Credits: 4 Marks: 100 (Internal: 20; External: 80)**

**Practical: 3 Hours/Week Credits: 1 Marks: 25**

**UNIT I:** Plant cell envelopes: Ultra structure of cell wall, molecular organization of cell membranes.

1. Models of membrane structure, Functions, fluidity and Selective permeability of the membranes.
2. Cell Organelles: Structure and semiautonomous nature of Mitochondria and Chloroplast.
3. Structure and role of endoplasmic reticulum, ribosomes, golgi complex, lysosomes, peroxisomes and glyoxisomes.

### UNIT-II

Nucleus: Ultra structure, types and functions of DNA & RNA.

4. Chromosomes: Morphology, organization of DNA in a chromosome, Euchromatin and Heterochromatin, Karyotype. Special types of chromosomes: Lampbrush and Polytene chromosomes.
5. Extra nuclear genome: Mitochondrial DNA and Plastid DNA.. Plasmids.
8. Cell division: Cell and its regulation; mitosis, meiosis and their significance

### UNIT- III

9. Plant -Water Relations: Physical properties of water, diffusion, imbibitions, osmosis; osmotic and pressure Potential, absorption and transport of water.
10. Mineral Nutrition: Essential macro and micro mineral nutrients, and symptoms of mineral deficiency.
11. Transpiration; Stomatal structure and movement. Mechanism of phloem transport. Mechanism of phloem transport.
12. Enzymes: Nomenclature, Characteristics, Classification and factors regulating enzyme activity.

### UNIT- IV

13. Photosynthesis: Photosynthetic pigments, Mechanism of photosynthetic electron transport and evolution of oxygen, Photophosphorylation . Carbon assimilation pathways: C3, C4 and CAM.
14. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle and electron transport system.
15. Nitrogen Metabolism: Biological nitrogen fixation
16. Physiological effects of Phytohormones: Auxins, gibberellins, cytokinins, ABA, ethylene and Brassinosteroids

## References:

1. Sharma, A. K. and A. Sharma. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harward Academic Publishers, Australia.
2. Shukla, R. S. and P. S. Chandel. 2007. Cytogenetics, Evolution, Biostatistics and Plant Breeding. S.Chand & Company Ltd., New Delhi.
3. Verma, P. S. and V. K. Agrawal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi. 1. Hopkins, W. G. 1995.
4. Introduction to Plant Physiology. John Wiley & Sons Inc., New York, USA
5. Jain, J.L., S. Jain and Nitin Jain. 2008. Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
6. Pandey, B. P. 2007. Botany for Degree Students: Plant Physiology, Biochemistry, Biotechnology, Ecology and Utilization of Plants. S. Chand & Company Ltd., New Delhi.
7. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4<sup>th</sup> edn. (India Edition), Wordsworth, Thomson Learning Inc.,USA.
8. Taiz, L. and E. Zeiger. 1998. Plant Physiology (2<sup>nd</sup> Ed.). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
9. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.

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**SEMESTER – IV**

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**CELL BIOLOGY AND PLANT PHYSIOLOGY  
PRACTICAL**

1. Demonstration of cytochemical methods: Fixation of plant material and nuclear staining for mitotic and meiotic studies.
2. Study of various stages of mitosis using cytological preparation of Onion root tips.
3. Study of various stages of meiosis using cytological preparation of onion flower buds.
4. Study of ultra structure of cell organelles using photographs. Chloroplast, Mitochondria, Nucleus, Ribosomes, Endoplasmic reticulum and Golgi complex.
5. Study of Special types of Chromosomes (Polytene chromosome and Lampbrush chromosomes-Permanent slide) ✓
6. Determination of osmotic potential of vacuolar sap by Plasmolytic method using leaves of *Rheodiscolor / Tradescantia*.
7. Determination of rate of transpiration using Cobalt chloride method
8. Determination of stomatal frequency using leaf epidermal peelings / impressions
9. Determination of catalase activity using potato tubers by titration method
10. Separation of chloroplast pigments using paper chromatography technique
11. Estimation of protein by Biurette method
12. Mineral deficiency- Detail study of Micronutrients and Macro nutrients
13. Identification of C<sub>3</sub>, C<sub>4</sub> and CAM plants.

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
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**SEMESTER – V**

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**PAPER – V: (A) BIODIVERSITY & CONSERVATION**  
**(DSE-1: ELECTIVE)**

**Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)**  
**Practical 3 Hours/Week Credits: 1 Marks: 25**

**UNIT – I**

1. Plant diversity and its scope: Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agro biodiversity and cultivated plant taxa, wild taxa.
2. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

**UNIT-II**

3. Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agro biodiversity, Projected scenario for biodiversity loss.
4. Management of Plant Biodiversity: Organizations associated with biodiversity, management- Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR.
5. Biodiversity legislation and conservation, Biodiversity information management and communication.

**UNIT-III:**

7. Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem Diversity
8. Principles of conservation : *In -situ* and *Ex-situ* conservation. Sacred groove, Botanical garden, Biosphere reserves, Sanctuaries, National parks (*In-situ*) and Tissue culture, Gene / seed / pollen banks and Cryopreservation (*Ex-situ*).

**UNIT-IV:**

9. Role of plants in relation to Human Welfare; Importance of forestry, their utilization and commercial aspects, Avenue trees, Ornamental plants of India.
10. Alcoholic beverages through ages. Fruits and nuts, Important fruit crops and their commercial importance. Wood and its uses.



### References:

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Bharucha, E. 2005. Textbook of Environmental Studies for Undergraduate Courses. Universities Press (India) Private Limited, Hyderabad.
3. Odum, E. P. 1983. Basics of Ecology. Saunder's International Students Edition, Philadelphia.
4. Sharma, P. D. 1989. Elements of Ecology. Rastogi Publications, Meerut.

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**SEMESTER – V**

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**PAPER – V:: (A) BIODIVERSITY & CONSERVATION PRACTICAL**  
**(DSE-1: ELECTIVE)**

1. Study on local biodiversity: Herbs, shrubs and trees; Seasonal, Annual, biennial and perennial plants.
2. Study of morphological characteristics of plant communities: Hydrophytes (*Eichhornia*, *Hydrilla*, *Pistia*, *Nymphaea*, *Vallisneria*), Xerophytes: (*Asparagus*, *Opuntia*, *Euphorbia milii*, *Casuarina*, *Calotropis*).
3. Assessment of biodiversity
  - i) Avenue trees: *Pongamiapinnata*, *Butea monosperma*, *Spathodea* sp., *Delonix regia*, *Jacaranda mimosifolia*, *Cassia fistula*, *Mimusopselengi*, *Acacia leucophloea*, and *Albizialebeck*.
  - ii) Ornamental Plants: Any five locally available ornamental plants.
  - iii) Timber Value: *Acacianilotica*, *Tectonagrandis* and *Azardirachta indica*
  - iv) Fruits: *Mangifera indica* (Mango), *Ziziphus mauritiana*, *Psidium guajava* (Guava), *Annona squamosa*
  - v) Nuts: *Anacardium occidentale* (Cashew), *Terminalia catappa* (Badam)
  - vi) Beverages: *Madhuca indica*, *Camellia sinensis* (Tea), *Coffea arabica* (Coffee), *Borassus flabellifer* (Toddy palm) and *Caryotaurens*
  - vii Medicinal value: *Catharanthus roseus*, *Tinosporacordifolia* and *Phyllanthus emblica*, *Ocimum* sp., and *Azardirachta indica*
4. Field trip: Collection of plants from the field, identification and preparation of Herbarium.

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**B.S.C. BOTANY III YEAR**  
**SEMESTER – V**

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**PAPER – V: (B) ECONOMIC BOTANY**  
**(DSE-1: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
 Practical 3 Hours/Week; Credits: 1 Marks: 25

**UNIT - I**

Origin of Cultivated Plants: Major plants introduction, Crop domestication and examples of crops / varieties

1. Vegetables: Nutritional and Commercial values of root crops, leafy and fruit vegetables.
2. Millets: Nutrient significance of Sorghum, Finger millet, Pearl millet, Foxtail millet.
3. Cereals: Rice, Wheat and maize - Origin, morphology and uses.

**UNIT – II**

4. Legumes: General account, importance to man and ecosystem.
5. Fruits and nuts: Commercial and nutritional value of South Indian fruits. Cashew nut, Almond and Walnut.
6. Sugars & Starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.
7. Spices: Listing of important spices, part used, economic importance with special reference to fennel, saffron, clove and black pepper

**UNIT – III**

8. Beverages: Tea, Coffee (morphology, processing & uses)
9. Edible oils & Fats: General description, extraction, uses and health implications of groundnut, sunflower, coconut, linseed, and mustard.
10. Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.
11. Natural Rubber: Para-rubber - tapping, processing and uses.

**UNIT – IV**

12. Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to *Cinchona*, *Digitalis*, *Papaver* and *Cannabis*.
13. Tobacco processing, uses and health hazards
14. Timber plants: General account with special reference to teak and pine
15. Fibres: Classification based on the origin of fibres, extraction methods and uses of Cotton and Jute.

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### **Suggested Readings**

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers.
4. B.P. Pandey (2007). Economic Botany, S. Chand & Company Ltd. New Delhi. 17/e.

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
**UNDER GRADUATE COURSES (UNDER CBCS 2021 – 2022 ONWARDS)**  
**B.SC. BOTANY III YEAR**  
**SEMESTER – V**

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**PAPER – V:: (B) ECONOMIC BOTANY PRACTICAL**  
**(DSE-1: ELECTIVE)**

1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests.
2. Identification and study on nutrient values of locally available vegetables, millets and cereals.
3. Study on nutrient values and commercial status of Cashew nut, Almond and Walnut.
4. Uses and health implications of groundnut, sunflower, coconut, linseed, Brassica and Coconut.
5. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
6. Study of products of economic importance included unit wise.
7. Collection vegetable twigs and preparation of Herbarium.
8. Identification of starch granules.
9. Estimation of iodine number of different oils.
10. Quantitative estimation and comparative study of proteins in millets and cereals.

B. Lalitaki Prasad Srinivas Reddy

**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
**UNDER GRADUATE COURSES (UNDER CBCS 2021 – 2022 ONWARDS)**  
**B.SC. BOTANY III YEAR**  
**SEMESTER – V**

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**PAPER – V:: (C) SEED TECHNOLOGY**  
**(DSE-1: ELECTIVE)**

**Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)**  
**Practical 3 Hours/Week; Credits: 1 Marks: 25**

**UNIT- I**

- 1. Seed: Structure and types. Seed development in cultivated plants, seed quality concept, importance of genetic purity of seed. Hybrid seed production and Heterosis.
- 2. Cross pollination, Emasculation, role of pollinators and their management.
- 3. Collection and storage of pollen for artificial pollination.

**UNIT-II**

- 4. Seed germination: Internal and external factors affecting germination.
- 5. Physiological processes during seed germination; seed respiration, breakdown and mobilization of stored seed reserves.
- 6. Seed dormancy: Types, causes and methods of breaking dormancy. Role of Phytochrome.

**UNIT-III**

- 7. Cultural practices and harvesting of Seed: Isolation, Sowing, Cultural practices, harvesting and threshing of the following crops: a) Rice b) Cotton c) Sunflower
- 8. Seed treatment to control seed borne disease –General account
- 9. Seed testing- Procedures of seed testing, seed testing laboratories and importance of seed testing.

**UNIT-IV**

- 10. Seed viability, factors affecting seed viability and genetic erosion.
- 11. Seed storage: Long term and short term storage. Orthodox and recalcitrant seeds. Packing of seeds – Principles, practices, bagging and labelling.
- 12. Seed banks- National, International and Millennium seed banks. Seed certification- History, Seed certification agency, Indian millennium, general and specific seed certification standard.

*C. Lalitha Nayak* *Sharma* *al*



## Reference:

1. Agrawal, P. K. 1993. Hand Book of Seed Technology. Dept. of Agriculture and Cooperation. National Seed Corporation Ltd., New Delhi
2. Balasubramanian, D., C. F. A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman. 2004. Biotechnology. Universities Press (India) Private Limited, Hyderabad.
3. Bedell, Y. E. Seed Science and Technology. Indian Forest Species. Allied Publishers Limited, New Delhi.
4. Channarayappa. 2007. Molecular Biotechnology – Principles and Practices. Universities Press (India) Private Limited, Hyderabad.
5. Chawala, H. S. 2002. Introduction to Plant Biotechnology. Oxford & IBH Publishing Company, New Delhi.
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7. Edmond, J. B., T. L. Senn, F. S. Adreus and R. J. Halfacre. 1977..
8. Hartman, H. T. and D. E. Kestler. 1976. Plant Propagation: Principles and Practices. Prentice & Hall of India, New Delhi.
9. Jha, T.B. and B. Ghosh. 2005. Plant Tissue Culture – Basic and Applied. Universities Press (India) Private Limited, Hyderabad..
10. Ramawat, K. G. 2008. Plant Biotechnology. S. Chand & Company Ltd., New Delhi.
11. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4th edn. (India Edition), Wordsworth, Thomson Learning Inc., USA..
12. Tiwari, G. N. and R. K. Goal. Green House Technology – Fundamentals, Design, Modelling and Application. Narosa Publishing House, New Delhi.
13. Tunwar, N. S. and S. V. Singh. 1988. Indian Minimum Seed Certification Standards. The Central Seed Certification Board, Govt. of India, New Delhi.
14. Agrawal PK & Dadlani M. (Eds.). 1992. *Techniques in Seed Science and Technology*. South Asian Publ.
15. Baskin CC & Baskin JM. 1998. Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination. Academic Press. Basra AS. 2006. Handbook of Seed Science and Technology. Food Product Press.
16. Bench ALR & Sanchez RA. 2004. *Handbook of Seed Physiology*. Food Product Press. Bewley JD & Black M. 1982. Physiology and Biochemistry of Seeds in Relation to Germination. Vols. I, II. Springer Verlag.
17. Bewley JD & Black M. 1985. *Seed: Physiology of Seed Development and Germination*. Plenum Press.
18. Copeland LO & Mc Donald MB. 1995. *Principles of Seed Science and Technology*. 3rd Ed. Chapman & Hall.
19. Khan AA. 1977. Physiology and Biochemistry of Seed Dormancy and Germination. North Holland Co.
20. Kigel J & Galili G. (Eds.). *Seed Development and Germination*. Marcel Dekker.
21. Murray DR. 1984. *Seed Physiology*. Vols. I, II. Academic Press. Sadasivam S & Manickam A. 1996. *Biochemical Methods*. 2nd Ed. New Age.

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**PAPER-2A: PLANT MOLECULAR BIOLOGY**  
**(DSE-2: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
Practical: 3 Hours/Week Credits: 1 Marks: 25

**UNIT-I**

1. Nucleic acids: Carriers of genetic information, types of genetic material, DNA as the carrier of genetic information.
2. Structures of DNA: Salient features and Types of DNA, Organization of DNA in Prokaryotes. Mitochondrial and chloroplast DNA.
3. Structure of RNA: Structure and Types of RNA's (mRNA, rRNA and tRNA).

**UNIT-II**

4. Nucleosome, Chromatin structure- Euchromatin, Heterochromatin; Constitutive and Facultative heterochromatin.
5. Replication of DNA: Chemistry of DNA synthesis, general principles, Semi-conservative replication of DNA, replication of linear ds-DNA, replication of the 5' end of linear chromosome.
6. Central dogma and genetic code: Central Dogma (Adaptor hypothesis and discovery of mRNA template), salient features of Genetic code.

**UNIT -III**

7. Mechanism of Transcription: Transcription in prokaryotes and eukaryotes; Split genes- concept of introns and exons, removal of introns, eukaryotic mRNA processing (5' cap, 3' polyA tail).
8. RNA editing and mRNA transport.

**UNIT -IV**

9. Translation in prokaryotes: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation.
10. Transcriptional regulation in prokaryotes, Regulation of lactose metabolism (*Lac* operon) and tryptophan (*Trp* operon) synthesis in *E.coli*.

*Sharma* *Ravi* *B. Lakshmi* *SP*

## Suggested Readings

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**PAPER-2A: PLANT MOLECULAR BIOLOGY PRACTICAL**  
**(DSE-2: ELECTIVE)**

1. Isolation of genomic DNA from E.Coli.
2. DNA isolation from cauliflower head./tomato fruit
3. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
4. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
5. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
6. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
7. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.
8. Estimation of size of a DNA fragment after electrophoresis using DNA markers (through photographs).

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**PAPER-2B: TISSUE CULTURE AND BIOTECHNOLOGY**  
**(DSE-2: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
Practical: 3 Hours/Week Credits: 1 Marks: 25

**UNIT - I**

1. Tissue culture: Introduction, sterilization procedures, explants, culture media- composition and preparation; Nutrients and hormone requirements. Micropropagation.
2. Organ culture: Totipotency, Induction of callus, Shoot, leaf culture, Anther culture, Ovule and Embryo culture.
3. Callus culture and isolation and fusion of protoplast culture
4. Organogenesis, Somatic and Zygotic embryogenesis

**UNIT- II**

5. Applications of tissue culture: Production of pathogen free plants and stress resistant plants, somaclonal variants and synthetic seeds.
6. Induction of hairy roots and its applications in production of secondary metabolites.
7. Haploidy and triploids, Cryopreservation and Germplasm Conservation.
8. Somatic hybrids and Cybrid

**UNIT- III**

9. Biotechnology: Introduction, history, scope and applications.
10. rDNA technology: Basic aspect of gene cloning, Enzymes used in gene cloning. Restriction enzymes, Ligases, Polymerases.
11. Gene cloning: Recombinant DNA, Bacterial Transformation and selection of recombinant clones, vectors- cloning vehicles (Plasmid, Cosmids, Bacteriophages, & Phasmids; Eukaryotic Vectors (YAC) Gene Construct; Applications of rDNA technology.

**UNIT - IV:**

10. Gene Libraries: construction of genomic and cDNA libraries, Polymerase Chain Reaction (PCR) and its applications.
11. Methods of gene transfer-*Agrobacterium* mediated Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment.

B. Lakshmi. Ram S. Sharma AP

12. Application of transgenics in improvement of crop productivity and quality traits. Pest resistant transgenic crops (Bt-cotton & Bt-brinjal); herbicide resistant plants (Roundup Ready soybean); crops with quality traits (Flavr Savr tomato, Golden rice).

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12. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
13. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
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15. Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

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**PAPER-2B: TISSUE CULTURE AND BIOTECHNOLOGY PRACTICAL**  
**(DSE-2: ELECTIVE)**

**Major Experiments**

1. Isolation of plant DNA (Tomato)
2. Production of synthetic seeds /Encapsulation of embryo
3. Preparation of plant tissue culture medium - MS medium
4. Isolation of protoplasts.

**Minor Experiments**

1. Callus induction
2. Demonstration of Micropropagation/multiple shoots
3. Anther culture
4. PCR – Demonstration
5. Study of biotechnology products: Samples of antibiotics and vaccines
6. Photographs of Gene transfer methods.
7. Instruments used in Biotechnology lab- Autoclave, Laminar air flow, Hot air oven and Incubator.
8. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.

**Spotting**

1. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
2. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
3. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
4. Restriction digestion and gel electrophoresis of plasmid DNA.

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**PAPER-2C: ANALYTICAL TECHNIQUES IN PLANT SCIENCES**  
**(DSE-2: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
Practical: 3 Hours/Week Credits: 1 Marks: 25

**Unit -I**

1. Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy.
2. Use of fluorochromes: Fluorescence-activated cell sorting (FACS); Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting.
3. Transmission and Scanning electron microscopy - sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

**Unit II:**

4. Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, analytical centrifugation, ultracentrifugation, marker enzymes.
5. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment.
6. Spectrophotometry: Principle and its application in biological research.

**Unit –III**

7. Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion exchange chromatography; Molecular sieve chromatography; Affinity chromatography.
8. Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids;
9. Electrophoresis: PAGE, SDS-PAGE

**Unit IV:**

10. Biostatistics: Statistics, population, samples, parameters;
11. Representation of Data: Tabular, Graphical; Measures of central tendency:
12. Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

**Suggested Readings**

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

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**PAPER-2C: ANALYTICAL TECHNIQUES IN PLANT SCIENCES**  
**PRACTICALS**  
**(DSE-2: ELECTIVE)**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

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**PAPER-2A: PLANT MOLECULAR BIOLOGY**  
**(DSE-2: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
Practical: 3 Hours/Week Credits: 1 Marks: 25

**UNIT-I**

1. Nucleic acids: Carriers of genetic information, types of genetic material, DNA as the carrier of genetic information.
2. Structures of DNA: Salient features and Types of DNA, Organization of DNA in Prokaryotes. Mitochondrial and chloroplast DNA.
3. Structure of RNA: Structure and Types of RNA's (mRNA, rRNA and tRNA).

**UNIT-II**

4. Nucleosome, Chromatin structure- Euchromatin, Heterochromatin; Constitutive and Facultative heterochromatin.
5. Replication of DNA: Chemistry of DNA synthesis, general principles, Semi-conservative replication of DNA, replication of linear ds-DNA, replication of the 5' end of linear chromosome.
6. Central dogma and genetic code: Central Dogma (Adaptor hypothesis and discovery of mRNA template), salient features of Genetic code.

**UNIT -III**

7. Mechanism of Transcription: Transcription in prokaryotes and eukaryotes; Split genes- concept of introns and exons, removal of introns, eukaryotic mRNA processing (5' cap, 3' polyA tail).
8. RNA editing and mRNA transport.

**UNIT -IV**

9. Translation in prokaryotes: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation.
10. Transcriptional regulation in prokaryotes, Regulation of lactose metabolism (*Lac* operon) and tryptophan (*Trp* operon) synthesis in *E.coli*.

*Sharma* *Manoj* *B. Lakshmi* *SP*

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**PAPER-2A: PLANT MOLECULAR BIOLOGY PRACTICAL**  
**(DSE-2: ELECTIVE)**

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7. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.
8. Estimation of size of a DNA fragment after electrophoresis using DNA markers (through photographs).

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
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**PAPER-2B: TISSUE CULTURE AND BIOTECHNOLOGY**  
**(DSE-2: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
Practical: 3 Hours/Week Credits: 1 Marks: 25

**UNIT - I**

1. Tissue culture: Introduction, sterilization procedures, explants, culture media- composition and preparation; Nutrients and hormone requirements. Micropropagation.
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3. Callus culture and isolation and fusion of protoplast culture
4. Organogenesis, Somatic and Zygotic embryogenesis

**UNIT- II**

5. Applications of tissue culture: Production of pathogen free plants and stress resistant plants, somaclonal variants and synthetic seeds.
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**UNIT - IV:**

10. Gene Libraries: construction of genomic and cDNA libraries, Polymerase Chain Reaction (PCR) and its applications.
11. Methods of gene transfer-*Agrobacterium* mediated Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment.

B. Lakshmi. Ram S. Sharma AP



12. Application of transgenics in improvement of crop productivity and quality traits. Pest resistant transgenic crops (Bt-cotton & Bt-brinjal); herbicide resistant plants (Roundup Ready soybean); crops with quality traits (Flavr Savr tomato, Golden rice).

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**PAPER-2B: TISSUE CULTURE AND BIOTECHNOLOGY PRACTICAL**  
**(DSE-2: ELECTIVE)**

**Major Experiments**

1. Isolation of plant DNA (Tomato)
2. Production of synthetic seeds /Encapsulation of embryo
3. Preparation of plant tissue culture medium - MS medium
4. Isolation of protoplasts.

**Minor Experiments**

1. Callus induction
2. Demonstration of Micropropagation/multiple shoots
3. Anther culture
4. PCR – Demonstration
5. Study of biotechnology products: Samples of antibiotics and vaccines
6. Photographs of Gene transfer methods.
7. Instruments used in Biotechnology lab- Autoclave, Laminar air flow, Hot air oven and Incubator.
8. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.

**Spotting**

1. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
2. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
3. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
4. Restriction digestion and gel electrophoresis of plasmid DNA.

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**PAPER-2C: ANALYTICAL TECHNIQUES IN PLANT SCIENCES**  
**(DSE-2: ELECTIVE)**

Theory: 4 Hours/Week; Credits: 4 Marks: 100 (Internal: 20; External: 80)  
Practical: 3 Hours/Week Credits: 1 Marks: 25

**Unit -I**

1. Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy.
2. Use of fluorochromes: Fluorescence-activated cell sorting (FACS); Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting.
3. Transmission and Scanning electron microscopy - sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

**Unit II:**

4. Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, , analytical centrifugation, ultracentrifugation, marker enzymes.
5. Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment.
6. Spectrophotometry: Principle and its application in biological research.

**Unit –III**

7. Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion exchange chromatography; Molecular sieve chromatography; Affinity chromatography.
8. Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids;
9. Electrophoresis: PAGE, SDS-PAGE

**Unit IV:**

10. Biostatistics: Statistics, , population, samples, parameters;
11. Representation of Data: Tabular, Graphical; Measures of central tendency:
12. Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

**Suggested Readings**

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGrawHill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

*B. Lakshmi Narayana*

*Shree*

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
Under Graduate Courses (Under CBCS 2021 – 2022 onwards)  
**B.SC. BOTANY III YEAR**  
**SEMESTER – VI**

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**PAPER-2C: ANALYTICAL TECHNIQUES IN PLANT SCIENCES**  
**PRACTICALS**  
**(DSE-2: ELECTIVE)**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. Preparation of permanent slides (double staining).

*B. Lalitha Devi* *Stamp* *of*



**KAKATIYA UNIVERSITY**  
Under Graduate Courses (Under CBCS 2019 - 2022)  
**B.Sc. ZOOLOGY I Year**  
**SEMESTER – I**

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**ANIMAL DIVERSITY – INVERTEBRATES**  
**(Core Paper –I)**

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

### UNIT – I

#### 1.1 Protozoa

- 1.1.1 General Characters and Classification of Protozoa up to Orders with examples
- 1.1.2 Type Study – *Elphidium*
- 1.1.3 Locomotion and Reproduction
- 1.1.4 Epidemiology of Protozoan diseases – Amoebiasis, Giardiasis, Leishmaniasis, Malaria

#### 1.2 Porifera

- 1.2.1 General characters and Classification of Porifera up to Orders with examples
- 1.2.2 Type study - *Sycon*
- 1.2.3 Canal system in Sponges
- 1.2.4 Types of Cells and Spicules in Porifera.

### UNIT – II

#### 2.1 Cnidaria

- 2.1.1 General characters and Classification of Cnidaria up to classes with examples
- 2.1.2 Type study - *Obelia*
- 2.1.3 Polymorphism in Cnidarians with examples
- 2.1.4 Corals and Coral Reef formation

#### 2.2 Helminthes


- 2.2.1 General characters and Classification of **Platyhelminthes** up to classes with examples
- 2.2.2 Type study - *Schistosoma*
- 2.2.3 General characters and Classification of **Nemathelminthes** up to classes with examples
- 2.2.4 Type study – *Dracanculus*; Parasitic Adaptations in Helminthes

### UNIT– III

#### 3.1 Annelida

- 3.1.1 General characters and Classification of Annelida up to classes with examples
- 3.1.2 Type study – *Hirudinaria granulosa*
- 3.1.3 Evolutionary significance of Coelome and Coelomoducts and Metamerism
- 3.1.4 Economic Importance of Annelida (Polychaeta, Oligochaeta and Hirudinea)

  
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Board of Studies  
Department of Zoology & Sericulture Unit  
KAKATIYA UNIVERSITY - WGL-506009 (T.S.)

### 3.2 Arthropoda

- 3.2.1 General characters; Classification of Arthropoda upto classes with examples
- 3.2.2 Type study – *Palaemon* (Prawn)
- 3.2.3 Crustacean Larvae; Insect metamorphosis; Useful and Harmful Insects
- 3.2.4 *Peripatus*- Structure and affinities

## UNIT – IV

### 4.1 Mollusca

- 4.1.1 General characters; Classification of Mollusca upto classes with examples
- 4.1.2 Type study - *Pila* (Snail)
- 4.1.3 Pearl formation; Torsion and Detorsion in Gastropods
- 4.1.4 Molluscs as Bio-indicators, Vectors and Pests; Economic importance

### 4.2 Echinodermata

- 4.2.1 General characters and Classification of Echinodermata upto classes with examples
- 4.2.2 Type study- *Star Fish*
- 4.2.3 Echinoderm larvae and their evolutionary significance
- 4.2.4 Autotomy, Regeneration and Symmetry of Echinoderms

### Suggested Readings:

1. L.H. Hyman 'The Invertebrates' Vol I, II and V. – M.C. Graw Hill Company Ltd.
2. Kotpal, R.L. 1988 - 1992 Protozoa, Porifera, Coelenterata, Helminthes, Arthropoda, Mollusca, Echinodermata. Rastogi Publications, Meerut.
3. E.L. Jordan and P.S. Verma 'Invertebrate Zoology' S. Chand and Company.
4. R.D. Barnes 'Invertebrate Zoology' by: W.B. Saunders CO., 1986.
5. Barrington. E.J.W., 'Invertebrate structure and Function' by ELBS.
6. P.S. Dhama and J.K. Dhama. Invertebrate Zoology. S. Chand and Co. New Delhi.
7. Parker, T.J. and Haswell 'A text book of Zoology' by, W.A., Mac Millan Co. London.
8. Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition"

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**KAKATIYA UNIVERSITY**  
Under Graduate Courses (Under CBCS 2019 - 2022)  
**B.Sc. ZOOLOGY I Year**  
**SEMESTER – I**

**ANIMAL DIVERSITY - INVERTEBRATES**  
**(PRACTICAL)**

**Instruction: 3 hrs per week**  
**No. of Credits: 1**

- 1. Study of museum slides / specimens/models (Classification of animals up to orders)**
  - i) **Protozoa:** *Amoeba, Paramecium, Paramecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax*
  - ii) **Porifera:** *Sycon, Spongilla, Euspongia, Sycon- T.S & L.S, Spicules, Gemmule*
  - iii) **Coelenterata:** *Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula*
  - iv) **Platyhelminthes:** *Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus, Taenia solium, Schistosoma haematobium*
  - v) **Nemathelminthes:** *Ascaris (Male & Female), Dracunculus, Ancylostoma, Wuchereria*
  - vi) **Annelida:** *Nereis, Aphrodite, Chaetopterus, Hirudinaria, Trochophore larva*
  - vii) **Arthropoda:** *Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly.*
  - viii) **Mollusca:** *Chiton, Pila, Unio, Pterodo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva*
  - ix) **Echinodermata:** *Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva*
- 2. Demonstration of dissection / dissected / virtual dissection:**  
**Prawn:** Appendages, Digestive system, Nervous system, Mounting of Statocyst
- 3. Laboratory Record work shall be submitted at the time of practical examination**
- 4. An "Animal album"** containing photographs, cut outs, with appropriate write up about the abovementioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.
- 5. Computer aided techniques should be adopted as per UGC guide lines.**

**Suggested manuals:**

1. Practical Zoology- Invertebrates by S.S.Lal
2. Practical Zoology – Invertebrates by P.S.Verma
3. Practical Zoology – Invertebrates by K.P.Kurl

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**KAKATIYA UNIVERSITY**  
Under Graduate Courses (Under CBCS 2019 - 2022)  
**B.Sc. ZOOLOGY I Year**  
**SEMESTER – II**

**ANIMAL DIVERSITY – VERTEBRATES**  
(Core Paper – II)

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

**UNIT – I**

**1.1 Hemichordata**

- 1.1.1 General characters and Classification of Hemichordates upto classes with examples
- 1.1.2 *Balanoglossus*- Structure and affinities
- 1.1.3. Larval Significance (Tornaria)

**1.2. Protochordata**

- 1.2.1 General Characters and Classification of Chordates up to orders with examples
- 1.2.2 Salient features of Urochordata; Retrogressive metamorphosis in Urochordata
- 1.2.3 Salient features and affinities of Cephalochordata
- 1.2.4 General Characters of Cyclostomata; Comparison of *Petromyzon* and *Myxine*

**UNIT – II**

**2.1 Pisces**

- 2.1.1 General characters of and Classification of Pisces up to orders with examples
- 2.1.3 *Scoliodon*- Digestive, Respiratory, Circulatory and Nervous system
- 2.1.4 Types of Scales, Types of Fins
- 2.1.5 Migration in Fishes

**2.2 Amphibia**

- 2.2.1 General characters and Classification of Amphibians up to orders with examples.
- 2.2.2 *Rana tigrina*- Respiratory, Circulatory and Nervous systems
- 2.2.3 Parental care in Amphibians; Neoteny and Paedogenesis
- 2.2.4 Metamorphosis in Amphibians and its hormonal control

**Unit – III**

**3.1 Reptilia**

- 3.1.1 General characters and Classification of Reptilia up to orders with examples
- 3.1.2 *Calotes*- Digestive, Respiratory, Circulatory and Nervous systems
- 3.1.3 Temporal fossa in Reptiles and its evolutionary importance
- 3.1.4 Distinguished characters of Poisonous and Non-poisonous snakes

  
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### 3.2 Aves

- 3.2.1 General characters and Classification of Aves upto orders with examples.
- 3.2.2 *Columba livia*- Digestive, Respiratory, Circulatory and Nervous systems
- 3.2.3 Migration in Birds
- 3.2.4 Flight adaptation in Birds

### Unit – IV

#### 4.1 Mammalia

- 4.1.1 General characters and Classification of Mammalia upto orders with examples
- 4.1.2 *Rabbit*- Digestive, Respiratory, Circulatory and Nervous systems
- 4.1.3 Dentition in Mammals
- 4.1.4 Aquatic adaptations in Mammals

#### Suggested Readings:

1. **E.L. Jordan and P.S. Verma** 'Chordate Zoology' - S. Chand Publications.
2. **Mohan P. Arora**. 'Chordata – I, Himalaya Publishing House Pvt. Ltd.
3. **Marshal, Parker and Haswell** 'Text book of Vertebrates'. ELBS and McMillan, England.
4. **Alfred Sherwood Romer**. Thomas S. Pearson 'The Vertebrate Body, Sixth edition, CBS College Publishing, Saunders College Publishing
5. **George C. Kent, Robert K. Carr**. *Comparative Anatomy of the Vertebrates*, 9th ed. McGraw Hill.
6. **Kenneth Kardong** *Vertebrates: Comparative Anatomy, Function and Evolution*, 4th ed, 'McGraw Hill.
7. **J.W. Young**, *The Life of Vertebrates*, 3rd ed, Oxford University press.
8. **Harvey Pough F, Christine M. Janis, B. Heiser**, *Vertebrate Life*, Pearson, 6th ed, Pearson Education Inc. 2002.

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**KAKATIYA UNIVERSITY**  
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**B.Sc. ZOOLOGY I Year**  
**SEMESTER – II**

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**ANIMAL DIVERSITY - VERTEBRATES**  
**(PRACTICAL)**

**Instruction: 3 hrs per week**

**No. of Credits: 1**

**I. Study of museum slides / specimens / models (Classification of animals up to orders)**

1. **Hemichordata:** *Balanoglossus, Tornmaria larva*
2. **Protochordata:** *Amphioxus, Amphioxus T.S. through pharynx*
3. **Cyclostomata:** *Petromyzon, Myxine, Ammocoetus larva*
4. **Pisces:** *Sphyrna, Pristis, Torpedo, Channa, Pleuronectes, Hippocampus, Exocoetus, Echieneis, Labeo, Catla, Clarius, Auguilla, Protopterus, Scales: Placoid, Cycloid, Ctenoid*
5. **Amphibia:** *Ichthyophis, Amblystoma, Siren, Hyla, Rachophous, Bufo, Rana, Axolotal larva*
6. **Reptilia :** *Draco, Chamaeleon, Gecko, Uromastix, Vipera russeli, Naja, Bungarus, Enhydrina, Typhlops, Ptyas, Testudo, Trionyx, Crocodilus*
7. **Aves:** *Archaeopteryx, Passer, Psittacula, Bubo, Alcedo, Columba, Corvus, Pavo, Collection and study of different types of feathers: Quill, Contour, Filoplume, Down*
8. **Mammalia:** *Ornithorhynchus, Tachyglossus, Pteropus, Funambulus, Manis, Loris, Hedgehog;*
9. **Histology:** T.S. of Liver, Pancreas, Kidney, Stomach, Intestine, Lung, Artery, Vein, Bone T.S, Spinal Cord. T.S.

**II. Osteology:**

**Rabbit – Axial Skeleton** (Bones of Skull and Vertebral Column),

**Varanus, Pigeon and Rabbit - Appendicular skeleton** (Bones of Limbs and Girdles)

**III. Demonstration of dissection / dissected / virtual dissection: Labeo / Tilapia**

1. Digestive system 2. Brain, Weberian Oscicles 3. V, VII, IX, X cranial nerves

**IV. Laboratory Record work shall be submitted at the time of practical examination**

**V. An “Animal album”** containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

**VI. Computer aided techniques should be adopted as per UGC guide lines.**

**Suggested manuals:**

1. S.S.Lal, Practical Zoology – Vertebrata

2. P.S.Verma, A manual of Practical Zoology– Chordata

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**KAKATIYA UNIVERSITY**  
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**B.Sc. ZOOLOGY II Year**  
**SEMESTER – III**

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**ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR**

<b>Theory</b>	<b>4 Hours/Week</b>	<b>4 Credit</b>	<b>Internal marks = 20</b>
<b>Practical</b>	<b>3 Hours/Week</b>	<b>1 Credit</b>	<b>External Marks = 80</b>

## **UNIT – I**

### **1.1 Digestion**

- 1.1.1 **Enzymes:** Definition, Classification, Inhibition, Regulation
- 1.1.2 Digestion of Carbohydrates, Proteins, Lipids and Cellulose
- 1.1.3 Absorption and Assimilation of digested food
- 1.1.4 Role of Gastrointestinal hormones in digestion

### **1.2 Excretion, Homeostasis and Osmoregulation**

- 1.2.1 Classification of Animals on the basis of excretory products: Ammonotelic, Ureotelic, and Uricotelic; Structure and function of Nephron
- 1.2.2 Urine formation and Counter current mechanism
- 1.2.3 Concept and Mechanism of Homeostasis
  - a) Hormone regulation of Blood Glucose levels in Human being
  - b) Water and Ionic Regulation by Marine and Fresh water Animals
  - c) Thermo regulation in Human being
- 1.2.4 Osmoregulation in Marine, Fresh and Brackish water Animals

## **UNIT – II**

### **2.1 Respiration**

- 2.1.1 Definition of Respiration, Respiration mechanism, External, Internal and Cellular Respiration.
- 2.1.2 Respiratory Pigments; Transport of Oxygen, Oxygen dissociation curves, and Bohr's Effect;
- 2.1.3 Transport of Carbon dioxide, Chloride shift
- 2.1.4 Regulation of Respiration; Nervous and Chemical Mechanism

### **2.2 Circulation**

- 2.2.1 Types of Circulation Open and Closed; Structure of Mammalian Heart
- 2.2.2 Types of Hearts: Myogenic and Neurogenic
- 2.2.3 Heart functions - Conduction and Regulation of Heart beat, Regulation of Heart rate; ECG
- 2.2.4 Tachycardia and Bradycardia; Blood Clotting mechanism

## **UNIT – III**

### **3.1 Muscle Contraction**

- 3.1.1 Types of Muscles
- 3.1.2 Ultra structure of skeletal muscle fibre
- 3.1.3 Mechanism and Chemical changes during Muscle Contraction (Sliding filament theory)
- 3.1.4 Twitch Tetanus summation and Treppe fatigue



## 3.2 Nerve Impulse

3.2.1 Structure of Neuron

3.2.2 Nerve impulse - Resting potential, Threshold potential and Action potential, Conduction of Nerve impulse

3.2.3 Transmission of Nerve impulse

3.2.4 Synapse and Synaptic transmission; Neurotransmitters-EPSP, IPSP

## 3.3 Endocrine System

3.3.1 Endocrine glands - Structure, secretions and functions of Pituitary gland

3.3.2 Thyroid, Parathyroid, Adrenal glands and Pancreas

3.3.3 Hormone action and Concept of Secondary messengers

3.3.4 Male and Female Hormones; Hormonal control of Menstrual cycle in human beings

## UNIT – IV

### 4.1 Animal Behaviour

4.1.1 Types of Behaviour- Innate and Acquired; Instinctive and Motivated behaviour

4.1.2 Taxes, Reflexes, Tropisms

### 4.2 Learning and Memory

4.2.1 **Types of Learning:** Trial and Error Learning, Imprinting, Habituation

4.2.2 **Conditioning:** Classical Conditioning; Instrumental conditioning, Examples of Conditioning, Pavlov's Experiment

### 4.3 Social Behaviour and Communication

4.3.1 Social behaviour of insects (Dance language of honey bees) Colonial Existence of Bees and Termites; Pheromones

### 4.4 Biological Rhythms

4.4.1 Biological Clocks, Circadian Rhythms; solar and lunar Rhythms; Circannual Rhythms

## Suggested Readings:

1. **Gerard J. Tortora and Sandra Reynolds Garbowski** *Principles of Anatomy and Physiology*, Tenth Ed., John Wiley & Sons
2. **Arthur C. Guyton MD**, *A Text Book of Medical Physiology*, Eleventh ed., John E. Hall, Harcourt Asia Ltd.
3. **William F. Ganong**, *A Review of Medical Physiology*, 22 ed, McGraw Hill, 2005
4. **Sherwood, Klandrof, Yanc**, *Animal Physiology*, Thompson Brooks/Coole, 2005.
5. **Sherwood, Klandrof, Yanc**, *Human Physiology*, Thompson Brooks/Coole, 2005.
6. **Knut Schmidt-Nielson**, *Animal Physiology*, 5th edition, Cambridge Low Price Edition.
7. **Roger Eckert and Randal**, *Animal Physiology*, 4th ed, Freeman Co, New York.
8. **Singh. H.R**, *Text Book of Animal Physiology and Biochemistry*
9. **Nagabhushanam**, *Comparative Animal Physiology*
10. **Veer Bal Rastogi**, *Text Book of Animal Physiology*
11. **Dasmann**, "Wild Life Biology"
12. **Reena Mathur**, "Animal Behaviour"
13. **Alocock**, "Animal Behaviour- an Evolutionary Approach"

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**KAKATIYA UNIVERSITY**  
Under Graduate Courses (Under CBCS 2019 - 2022)  
**B.Sc. ZOOLOGY II Year**  
**SEMESTER – III**

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**ANIMAL PHYSIOLOGY AND ANIMAL BEHAVIOUR**  
**(PRACTICAL)**

**Instruction: 3 hrs per week**

**No. of Credits: 1**

1. Qualitative tests for identification of carbohydrates, proteins and fats
2. Qualitative tests for identification of ammonia, urea and uric acid  
(Nitrogenous excretory products)
3. Zonation of gut in Cockroaches
4. Study on effect of pH and Temperature on salivary amylase activity
5. Study of permanent histological sections of mammalian endocrinal glands: Pituitary, Thyroid, Pancreas, Adrenal gland
6. Estimation of Haemoglobin by Sahli's method
7. Estimation of Blood Clotting time
8. Estimation of total protein by Biuret's method
9. Estimation of unit metabolism of fish

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

**Suggested manuals:**

**Tortora, G.J. and Derrickson, B.H. (2009).***Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.

**Widmaier, E.P., Raff, H. and Strang, K.T. (2008)** *Vander's Human Physiology*, XI Edition., McGraw Hill

**Guyton, A.C. and Hall, J.E. (2011).** *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

**Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).***Biochemistry*.VI Edition. W.H Freeman and Co.

**Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009).***Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.

**Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009).**

*Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

**KAKATIYA UNIVERSITY**  
Under Graduate Courses (Under CBCS 2019 - 2022)  
**B.Sc. ZOOLOGY II Year**  
**SEMESTER – IV**

**CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY**

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

**UNIT – I**

**1.1 Cell Biology**

- 1.1.1 Ultra structure of Animal cell
- 1.1.2 Structure (Fluid mosaic model) and Functions of Plasma membrane
- 1.1.3 Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Ribosomes, Lysosomes, Mitochondria and Nucleus
- 1.1.4 Chromosomes - Structure, types, Cell Division- Mitosis, Meiosis, Cell Cycle and its regulation.

**UNIT – II**

**2.1 Molecular Biology**

- 2.1.1 DNA (Deoxyribo Nucleic Acid) –Structure-RNA (Ribo Nucleic Acid)-Structure, types, DNA Replication
- 2.1.2 Protein Synthesis – Transcription, Translation.
- 2.1.3 Gene Expression - Genetic Code, Operon concept.
- 2.1.4 Molecular Biology Techniques – Polymerase Chain Reaction (PCR), Electrophoresis.

**UNIT – III**


**3.1 Genetics**


- 3.1.1 Mendel's laws of Inheritance and Non-Mendelian Inheritance , Linkage and Crossing over.
- 3.1.2 Sex determination and Sex-linked inheritance.
- 3.1.3 Chromosomal Mutations- Deletion, Duplication, Inversion, Translocation; Aneuploidy and Polyploidy; Gene mutations- Induced versus Spontaneous mutations
- 3.1.4 Inborn errors of metabolism.

**UNIT – IV**

**4.1 Developmental Biology**

- 4.1.1 Gametogenesis (Spermatogenesis and Oogenesis), Fertilization, Types of eggs, Types of cleavages
- 4.1.2 Development of Frog upto the formation of primary germ layers
- 4.1.3 Formation of Foetal membrane in chick embryo and their functions
- 4.1.4 Types and functions of Placenta in Mammals, Regeneration in Turbellarians and Lizards

  
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**Suggested Readings:**

1. **Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnell** '*Molecular Cell Biology*'  
W.H. Free man and company New York.
2. **Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008).** *Principles of Genetics*. VIII Edition.  
Wiley India.
- 3 **Snustad, D.P., Simmons, M.J. (2009).** *Principles of Genetics*. V Edition. John Wiley and  
Sons Inc.
- 4 **Klug, W.S., Cummings, M.R., Spencer, C.A. (2012).** *Concepts of Genetics*. X Edition.  
Benjamin Cummings.
5. **Russell, P. J. (2009).** *Genetics- A Molecular Approach*. III Edition. Benjamin Cummings.
6. **Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.** *Introduction to Genetic  
Analysis*. IX Edition. W. H. Freeman and Co.
7. **Ridley, M. (2004).** *Evolution*. III Edition. Blackwell Publishing
8. **Campbell, N. A. and Reece J. B. (2011).** *Biology*. IX Edition, Pearson, Benjamin,  
Cummings.
9. **James D. Watson, Nancy H. Hopkins** '*Molecular Biology of the Gene*'
10. **Gupta P.K.**, 'Genetics'

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**KAKATIYA UNIVERSITY**  
Under Graduate Courses (Under CBCS 2019 - 2022)  
**B.Sc. ZOOLOGY II Year**  
**SEMESTER – IV**

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**CELL BIOLOGY, GENETICS & DEVELOPMENTAL BIOLOGY**  
**PRACTICAL**

**Instruction: 3 hrs per week**

**No. of Credits: 1**

**I. Cytology**

1. Preparation and Identification of slides of Mitotic divisions with onion root tips
2. Preparation and Identification of different stages of Meiosis in Grasshopper Testes
3. Identification and study of the following slides
  - i). Different stages of Mitosis and Meiosis
  - ii) Lamp brush and polytene chromosomes

**II. Genetics**

1. Problems on Genetics - Mendelian inheritance, Linkage and Crossing over, Sex linked inheritance

**III. Embryology**

1. Study of T.S. of Testis and Ovary of a mammal
2. Study of different stages of cleavages (2, 4, 8, 16 cell stages); Morula, Blastula
3. Study of chick embryos of 18 hours, 24 hours, 33 hours and 48 hours of incubation

**IV. Laboratory Record work shall be submitted at the time of practical examination**


**V. An "Album" containing photographs, cut outs, with appropriate write-up about Genetics and Embryology**


- **Computer aided techniques should be adopted as per UGC guide lines.**

**Suggested manuals:**

1. Manual of laboratory experiments in Cell Biology by **Edward, G.**
2. Freeman and Bracegirdle – An Atlas of Embryology.

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**KAKATIYA UNIVERSITY**  
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**B.Sc. ZOOLOGY III Year**  
**SEMESTER – V**

**IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

**UNIT – I**

**1.1 Basics of Immune system**

- 1.1.1 Cells of the Immune system and the Lymphoid organs (Primary and Secondary)
- 1.1.2 First line of defences-physical and chemical barriers; second line of defences – inflammation and phagocytosis.
- 1.1.3 Types of Immunity- Inherent (Active and Passive) and Acquired Immunity (Active and Passive) Humoral and Cell mediated immunity.
- 1.1.4 Major Histocompatibility complex (MHC)- structure and function of class I and Class II proteins. Significance of MHC in organ transplantation; MHC restriction

**UNIT – II**

**2.1 Antibodies and Antigens and Immune system diseases**

- 2.1.1 Antibodies(Immunoglobulins) – Structure, functions and classification, antibody diversity, Monoclonal antibodies and applications
- 2.1.2 Antigens structure, antigenic determinants/epitopes, haptens, adjuvants and antigenicity.
- 2.1.3 Antigen-antibody reactions; Agglutination; Precipitation, Opsonization, Cytotoxicity
- 2.1.4 Hypersensitivity reactions.  
Autoimmunity and Immunodeficiency diseases.

**Unit – III**

**3.1 Animal Biotechnology and Genetically modified organisms**

- 3.1.1 Concept and Scope of Animal Biotechnology
- 3.1.2 Recombinant DNA Technology and its applications.
- 3.1.3 Cloning Vectors- Plasmids, Cosmids and shuttle vectors, Cloning methods(Cell, Animal and Gene cloning); Restriction enzymes and Ligases
- 3.1.4 Transgenesis – Methods of Transgenesis  
Production of Transgenic animals- Sheep and Fish

**Unit – IV**

**4.1 Applications of Biotechnology**

- 4.1.1 In vitro fertilization and embryo transfer
- 4.1.2 Hybridoma technology – concepts and applications
- 4.1.3 Stem cells- Types and their applications
- 4.1.4 Recombinant insulin and human growth hormone; Polymerase Chain Reaction (PCR)  
Animal Bioreactors- Concepts and Applications.

  
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### Suggested Readings:

1. Text Book of Immunology – Ivan Riott
2. Text Book of Immunology – C.V.Rao
3. Text Book of Immunology – Nandinin Shetty
4. Text Book of Immunology – Kubey
5. Culture of Animal Cells – R. Ian Freshney, Wiley Liss
6. Biotechnology – S. Mitra
7. Animal Cell Culture - Practical Approach – Ed. John. RW. Masters, Oxford
8. Biotechnology – B.D.Singh
9. Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.
10. Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

  
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**B.Sc. ZOOLOGY III Year**  
**SEMESTER – V**

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**IMMUNOLOGY AND ANIMAL BIOTECHNOLOGY**  
**PRACTICAL**

Instruction: 3 hrs per week

No. of Credits: 1

**I. Immunology**

1. Identification of Blood grouping (Demonstration of Agglutination) using kit.
2. Demonstration of Precipitation (VDRL/RPR) using kit.
3. Histological study of Lymphoid organs -Spleen, Thymus, Lymph node, Bone marrow (through prepared slides).
4. Enumeration of Total RBC from a given blood sample.
5. Enumeration of Total WBC from a given blood sample.
6. Enumeration of Differential count of WBC from a given blood sample.

**II. Animal Biotechnology**

1. Study the following techniques through Photographs / Virtual Lab


- a) Identification of Vectors
- b) Identification of Transgenic animals
- c) DNA sequencing (Sanger's method)
- d) DNA finger printing
- e) Southern blotting
- f) Western blotting

2. PCR (demonstration) on site or of site demonstration.

- **Laboratory Record work shall be submitted at the time of practical examination**
- **Computer aided techniques should be adopted as per UGC guide lines.**

**Suggested manuals:**

1. A Hand Book of Practical Immunology – **Ivan Riott**
2. Animal Biotechnology – **P.K. Gupta.**
3. Immunology, VI Edition. W.H. Freeman and Company **Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006).**
4. Immunology, VII Edition, Mosby, Elsevier Publication **David, M., Jonathan, B., David, R. B. and Ivan R. (2006).**
5. Cellular and Molecular Immunology. V Edition. Saunders Publication, **Abbas, K. Abul and Lechtman H. Andrew (2003.)**

  
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**SEMESTER – VI**

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**ECOLOGY, ZOOGEOGRAPHY AND EVOLUTION**

Theory	4 Hours/Week	4 Credit	Internal marks = 20
Practical	3 Hours/Week	1 Credit	External Marks = 80

**UNIT – I**

**1.1 Ecology- I**

- 1.1.1 Ecosystem Structure and Functions; Types of Ecosystems – Aquatic and Terrestrial
- 1.1.2 Bio-geo chemical nutrient cycles - Nitrogen, Carbon, Phosphorus and Water
- 1.1.3 Energy flow in ecosystem
- 1.1.4 Food chain, food web and ecological pyramids
- 1.1.5 Animal Associations-Mutualism; Commensalism; Parasitism; Competition, Predation

**UNIT – II**

**2.1 Ecology – II**

- 2.1.1 Concept of Species, Population dynamics and Growth curves
- 2.1.2 Community Structure and dynamics and Ecological Succession
- 2.1.3 Ecological Adaptations
- 2.1.4 Environmental Pollution- Sources, Effect and Control measures of Air, Water, Soil and Noise Pollution
- 2.1.5 Wildlife conservation - National Parks and Sanctuaries of India, Endangered species; Biodiversity and Hotspots of Biodiversity in India.

**UNIT – III**

**3.1 Zoogeography**

- 3.1.1 Zoogeographical regions
- 3.1.2 Climatic and faunal peculiarities of Palaearctic, Nearctic, Neotropical, Oriental, Australian and Ethiopian regions
- 3.1.3 Wallace line, Discontinuous distribution
- 3.1.4 Continental Drift

**Unit – IV**

**4.1. Evolution**

- 4.1.1 Theories of Evolution – Lamarckism, Neo-Lamarckism, Darwinism, Neo-Darwinism, Modern synthetic theory, Evidences of Evolution.
- 4.1.2 Forces of Evolution–Natural Selection, Genetic drift, Gene flow, Genetic load, Organic variations, Hardy Weinberg Equilibrium.
- 4.1.3 Isolation –Premating and post mating isolating mechanisms.
- 4.1.4 Speciation: Methods of Speciation - Allopatric and Sympatric; Causes and Role of Extinction in Evolution.

  
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### Suggested Readings:

1. Ecology – Himalaya Publishing company – M.P Arora
2. Environmental Biology – P.D. Sharma
3. Environmental Ecology – P.R. Trivedi and Gurdeep Raj
4. Indian Wildlife Threats and Prervation – Buddhadev Sharma and Te Kumar
5. Ecology-Principles and Application II Edn. Cambridge Univ Press, London, Champan. JL and Re.iss MJ.
6. Environmental Studies, TATA McGraw Hill Com. New Delhi, Benny Joseph.
7. Fundamentals of Ecology Third Edn., Nataraj Publishers, Dehradun, Eugene.P. Odum.
8. Ecology and Animal Distribution, Veea Bala Rastogi.
9. Text Book of Ecology and Environment, P.K. Gupta.
10. Ecology and Wildlife Biology, Bhatnagar and Bansal.
11. Evolution 3<sup>rd</sup> Edn. Blackwell Publishing, Ridley, M (2004).
12. Evolutionary Biology, Addison –Wesley; Minkoff,E(1983).
13. *Evolution*. Cold Spring, Harbour Laboratory Press Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).
14. *Evolution*. IV Edition. Jones and Bartlett Publishers; Hall, B. K. and Hallgrimsson, B. (2008).
15. *Evolution*, 2nd Edn, Oxford and IBH Publishing Co., New Delhi, Jan M. Savage.

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**SEMESTER – VI**

**ECOLOGY, ZOOGEOGRAPHY AND EVOLUTION  
PRACTICAL**

**Instruction: 3 hrs per week**  
**No. of Credits: 1**

**Ecology**

1. Determination of pH of Soil and Water.
2. Estimation of Salinity (Chlorides) of water in given samples.
3. Estimation of Carbonates and Bicarbonates in the given water samples.
4. Estimation of dissolved Oxygen of Pond water, sewage, effluents.
5. Identification of Zooplankton from different water bodies.
6. Study of Pond Ecosystem / Local polluted site – Report submission.

**Zoogeography**


1. Study of at least 3 endangered or threatened wild animals of India through photographs/specimens/models
2. Field visit to Zoo Park to study the management, behavior and enumeration of wild animals.
3. Identification of Zoogeographical realms from the Map and identify specific fauna of respective regions.


**Evolution**

1. Museum Study of fossil animals: **Peripatus; Coelacanth fish, Dipnoi fishes; Sphenodon; Archaeopteryx.**
  2. Study of homology and analogy from suitable specimens and pictures
  3. Problems on Hardy-Weinberg Law
  4. Macroevolution using Darwin finches (pictures)
- **Laboratory Record work shall be submitted at the time of practical examination**
  - **Computer aided techniques should be adopted as per UGC guide lines.**

**Suggested manuals:**

1. Ecology Student Lab Manual, Biology Labs – Robert Desharnais, Jeffrey Bell.
2. Ecology Lab manual – Darrell S Vodopich.

  
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**B.Sc. Dairy Science (Vocational Subject)**

**I Year II Semester**

**Paper 2: Dairy Husbandry - II**

**Theory Syllabus (4 Credits)**

**60 Lectures**

- Unit 1:** Systems of Housing of Dairy cattle – Loose Housing and Conventional Dairy Stanchion Barns. Drawing of layouts for dairy cattle dwellings; Criteria for selecting site for establishing Dairy farm buildings; Water requirement of dairy animals. (15)
- Unit 2:** Symptoms of sick Dairy animals. Diseases of Dairy animals – Bacterial, Viral, Parasitic and Nutritional deficiency diseases and their control. (15)
- Unit 3:** Management of different classes of Dairy animals – Milch animals, Pregnant animals, Dry animals, Heifers and Calves. Management practices for Dairy farm; Identification, Dehorning, Castration, Grooming, Deworming, Vaccination, Disinfection and Milking. (15)
- Unit 4:** Maintenance of high level of fertility in the herd: Importance, Reasons for low fertility, Methods of maintaining high level of fertility in the herd. Methods of determining reproductive efficiency: i) By non return percentage of cows, ii) By calving interval period iii) By pregnancy days of cows per year. (15)



**B.Sc. Dairy Science (Vocational Subject)**  
**I Year II Semester**  
**Paper 2: Dairy Husbandry - II**  
**Practical Syllabus (1 Credit)**

1. Dairy Farm layout.
2. Identification of cows.
3. Dehorning of calves.
4. Castration of bulls.
5. Deworming of dairy cattle.
6. Preparation of vaccination schedule of dairy cattle.
7. Identification of sick animals.
8. Tests for hardness of water.
9. Determining the strength of disinfectant and detergent solutions.

**Reference Books:**

1. Text Book of Animal Husbandry – G.C. Banerjee.
2. Hand Book of Animal Husbandry – ICAR Edition.

**B.Sc. Dairy Science (Vocational Subject)**

**II Year III Semester**

**Paper 3: Dairy Cattle Nutrition**

**Theory Syllabus (4 Credits)**

**60 Lectures**

- Unit 1:** Digestive system and role of nutrients in dairy cattle. Classification of Feeds and Fodder. Importance of proteins, fats and carbohydrates in livestock feeding. (15)
- Unit 2:** Types of Fodder varieties – Legumes and non-legumes, Seasonal and Perennial fodder crops. Cultivation practices of fodder crops – Para grass, Hybrid Napier, Berseem, Cow pea and Jowar. (15)
- Unit 3:** Feeding Standards; Balanced rations for Dairy cattle; Feeding practices of Dairy cattle i) Soiling ii) Ensiling iii) Pasturing iv) Hay feeding v) General feeding practices with regard to management. (15)
- Unit 4:** Utilization of agricultural and industrial by-products for livestock feeding. Enrichment of poor quality roughages – Urea treatment of paddy straw. (15)

**B.Sc. Dairy Science (Vocational Subject)**  
**II Year III Semester**  
**Paper 3: Dairy Cattle Nutrition**  
**Practical Syllabus (1 Credit)**

1. Identification of feeds and fodder.
2. Computation of rations.
3. Preparation of urea enriched paddy straw.
4. Determination of dry matter and moisture content in feed or fodder.
5. Determination of crude protein content by Kjeldahls method.

**Reference Books:**

1. Text Book of Animal Husbandry – G.C. Banerjee.
2. Principles and practices of Dairy farm – Jagdish Prasad.
3. Animal Nutrition and feeding practices – Dr. Surendra K. Ranjhan.
4. Dairy Chemistry and Animal Nutrition – M.M. Roy.



**B.Sc. II Year  
Semester-III  
Skill Enhancement Course**

**SEC-1(2 hrs/week)**

**(2 Credits) Lectures: 30**

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**Artificial Insemination**

**Unit-I**

1. Study of male and female reproductive systems. (4h)
2. Gametogenesis and Oestrus cycle. (4h)
3. Semen: Definition, Collection by AV method, Collection technique, Evaluation, Freezing, Handling and Storage. (6h)
4. Heat detection. (1h)

**Unit-II**

5. Study of AI Equipments. (4h)
6. Time and Technique of AI. (4h)
7. Pregnancy diagnosis. (2h)
8. Visits to Veterinary Hospitals and AI Centres. (5h)

**Reference Books:**

1. Advances in Dairy animal production – Mudgal.
2. Dairy Bovine production – CK Thomas.
3. Handbook of Animal husbandry – ICAR publication.
4. Animal husbandry and Dairy Science – Jagdish Prasad.
5. A text book of Animal husbandry - G E Banerjee.
6. Livestock production and management – NSR Sastri and Thomas.
7. Reproduction in farm animals – Hafeez.
8. Animal Genetics and Breeding – Dr. Satish Kulkarni, Dr. Pandurang Gangasagar.

**B.Sc. II Year  
Semester-III  
Skill Enhancement Course**

**SEC-2 (2 hrs/week)**

**(2 Credits) Lectures: 30**

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**Conservation of Green Fodder**

**Unit-I**

1. Principles of conservation and its significance. (3h)
2. Suitable crops for conservation and stage of harvesting. (3h)
3. Silage making: (9h)
  - a. Definition and Standards of Silage.
  - b. Types of silo pits and their dimensions.
  - c. Ensiling, care during and after ensiling.
  - d. Chemical changes during ensiling.

**Unit-II**

4. Hay making: (10h)
  - a. Definition
  - b. Characteristics of good quality hay
  - c. Curing of hay
  - d. Factors affecting quality of hay.
5. Visit to Silage and Hay Unit. (5h)

**Reference Books:**

1. Silage and Hay Making, ICAR – Chatterjee BN.
2. Applied Animal Nutrition-Feeds and Feeding – Peter R. Cheeke.
3. Tropical feeds, FAO – Gohl BO.
4. Fodder production and Grassland management for Veterinarians - Reddy DV.
5. Feeds and Principles of Animal Nutrition –Banerjee GC.
6. Animal nutrition and feeding practices in India – SK Ranjhan.

**B.Sc. Dairy Science (Vocational Subject)**  
**II Year IV Semester**  
**Paper 4: Dairy Development and Cooperative Societies**  
**Theory Syllabus (4 Credits)                      60 Lectures**

**Unit 1:** Advantages of Dairying. Principles involved in successful dairying. Systems of dairy farming – Mixed farming and specialized dairy farming. (15)

**Unit 2:** Methods of procurement of milk; Transportation of milk; Pricing of milk and marketing of milk. (15)

**Unit 3:** Cooperative Dairying – Structure of Dairy cooperatives; Primary milk producers Cooperative Society; District milk producers Cooperative Union; Objectives and functions. (15)

**Unit 4:** Dairy development programs implemented in India. Operation Flood program. Economics of maintaining Dairy Farm – Income and expenditure. Estimating the production cost of milk. (15)

**Note: On-Farm Training** for two weeks is compulsory during II year IV semester. Students need to submit report at IV semester Practical Exam for Evaluation (weightage of 20%).



**B.Sc. Dairy Science (Vocational Subject)**  
**II Year IV Semester**  
**Paper 4: Dairy Development and Cooperative Societies**  
**Practical Syllabus (1 Credit)**

1. Record keeping.
2. Preparation of project reports for various sizes of dairy farm.
3. Calculations on cost of milk production.
4. Calculating the cost of milk production exercises for various sizes of farms.

**Reference Books:**

1. Dairy management in India – Madan Mohan.
2. Text Book of Animal Husbandry – G.C. Banerjee.
3. Principles and practices of Dairy Farm – Jagdish Prasad.

**B.Sc. II Year**  
**Semester-IV**  
**Skill Enhancement Course**

**SEC-3 (2 hrs/week)**

**(2 Credits) Lectures: 30**

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**Concentrate Feeds and Agro industrial By-products in Animal Nutrition**

**Unit-I**

1. Study of Concentrates – Cereal grains and their nutritive value: (6h)
  - a. Oil seeds, Oil cakes and Nutritive value.
  - b. Study of Concentrates available in local market.
2. Concentrate by-products – Wheat bran, Rice bran, Maize gluten husk, Tur chuni, Gram chuni. (3h)
3. Industrial by-products – (3h)
  - a. Sugar Industrial by-products – Molasses, Press-mud, Bagasse, Sugarcane tops, UMMB, UROMOL.
  - b. Animal Industrial by-products – Fish meal, Bone meal, Blood meal, Poultry excreta and local market available by-products. (3h)

**Unit-II**

4. Fruits and Vegetables Industry by-products – Seed kernels, Hulls, Tomato (10h) pomace, Potato pomace, Apple pomace, Banana peels, Citrus peels, Pine apple waste, Leafy vegetable waste.
5. Visits to Fodder crops, Feed Factories, Oil industries, Fruits and Vegetable industries and Sugar industry by-products. (5h)

**Recommended Books:**

1. Animal Nutrition – Aron A Bondi, John Wiley and Sons, Britain, 1987.
2. Nutrient requirements of ruminant livestock - ARC, UK, 1984.
3. Handbook of Applied Animal Nutrition – Niranjana PS, Chahal US, Srivastava V & Kumar S. IBDC Publishers, Lucknow, 2010.
4. Animal Nutrition in the Tropics, 3<sup>rd</sup> Edn., - Ranjhan SK, 1993.
5. Applied Nutrition – Livestock, Poultry, Pets, Rabbits & Laboratory animals – Reddy DV, 2009.
6. Nutrient requirement of dairy cattle - NRC, 2001.

**B.Sc. II Year**  
**Semester-IV**  
**Skill Enhancement Course**

**SEC-4 (2 hrs/week)**

**(2 Credits) Lectures: 30**

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**Special Milks**

**Unit-I**

1. Introduction, Definition, Methods of manufacture and uses of Processed Special Milk: (5h)
  - a. Sterilized milk
  - b. Homogenized milk
2. Introduction, Definition, Methods of manufacture and uses of Value Added Special Milk: (5h)
  - a. Flavoured milk
  - b. Vitaminized milk/Irradiated milk/Fortified milk
3. Introduction, Definition, Methods of manufacture and uses of Fermented Special Milk: (5h)
  - a. Cultured Butter milk
  - b. Acidophilus milk

**Unit-II**

4. Introduction, Definition, Methods of manufacture and uses of Standardized Special Milk: (5h)
  - a. Toned milk
  - b. Double Toned milk
5. Introduction, Definition, Methods of manufacture and uses of Special Milk of Plants/Vegetable origin: (5h)
  - a. Soya milk
  - b. Groundnut milk
  - c. Almond milk
6. Visits to Milk processing plants, Fermentation plants, Soya processing plants, Food Foliage College. (5h)

**Reference Books:**

1. Outlines of Dairy Technology – SK De.
2. Milk and Milk Products – Eckless, Combs and Macacy.
3. Modern Dairy Product – Lampert.
4. Indigenous Milk Products – ICAR publication.
5. Market Milk Industry – CI Rhodhouse and JL Handerson.
6. Technology of Indian Milk Products – RP Aneja, BN Mathur, RC Chandan and AK Banerjee.

**B.Sc. Dairy Science (Vocational Subject)**  
**III Year V Semester**

**DSE-IA: Technology of Dairy Products - I**

**Theory Syllabus (4 Credits)**

**60 Lectures**

- Unit 1:** Reception of milk: Unloading, Grading, Sampling, Testing, Weighing and Recording. Storage of milk. Straining, filtration and clarification of milk. Definition and objectives of Pasteurization of milk, Objections to Pasteurization and Principles of heat exchange. (15)
- Unit2:** Methods of Pasteurization: LTLT, HTST and Uperization. Sterilization of milk. Factors influencing homogenization, effect of homogenization on milk. Standardization of milk. (15)
- Unit 3:** Packaging of milk: Desirable characters and types of packaging materials; Forms of packaging. Disposal of dairy effluents: Sources of dairy waste; Necessity of treatment of dairy waste; Methods of treatment: Low cost methods and Conventional methods - Activated sludge process and trickling filters. (15)
- Unit 4:** Market milk: Toned milk, Double toned milk, Reconstituted milk, Standardized milk and Full cream milk – Standards and methods of manufacture. Cream: Types of cream, composition, methods of cream separation, gravity and centrifugal methods, types of cream separators; factors affecting fat losses in skim milk and fat percentage in cream. (15)



**B.Sc. Dairy Science (Vocational Subject)**  
**III Year V Semester**  
**DSE-IA: Technology of Dairy Products - I**  
**Practical Syllabus (1 Credit)**

1. RMRD Testing of milk.
2. Standardization of milk.
3. Homogenization of milk.
4. Pasteurization of milk.
5. Sterilization of milk.
6. Preparation of toned milk and double toned milk.
7. Preparation of Reconstituted milk.
8. Cream separation.

**Reference Books:**

1. Dairy processing handbook – Gosta Bylund.
2. Outlines of Dairy Technology – Sukumar De.
3. Milk products preparation and quality control – C.P. Ananthkrishnan.
4. The technology of milk processing – C.P. Ananthkrishnan.
5. Modern Dairy products – Lincoln M. Lampert.

**B.Sc. Dairy Science (Vocational Course)**

**III Year V Semester**

**DSE-IB: Dairy Chemistry**

**Theory Syllabus (4 Credits)**

**60 Lectures**

**Unit 1:** (a) Composition of milk: Definition of milk, Composition of cow milk, buffalo milk, sheep milk, goat milk and human milk. Differences between the composition of cow and buffalo milks. Constituents of milk: Minor and major constituents.  
(b) Colostrums: Significance, Composition, difference between normal milk and colostrums. (15)

**Unit 2:** Factors affecting composition and yield of milk – Species, Breed, Individuality, Stage of lactation, Age of the animal, Season, Interval between milking, Stage of milking, Feed, Estruses, Exercise, Milker and Drugs. (15)

**Unit 3:** Physico-chemical properties of milk – Colour, Flavour, Density, Specific gravity, Freezing point, Boiling point, Surface tension, Viscosity, Specific heat, Refractive index, Electrical conductivity, Germicidal property, pH and acidity. (15)

**Unit 4:** (a) Chemistry of major constituents of milk b) Nutritive value of milk (c) Platform tests; Tests for detection of adulteration of milk; Preservatives and Neutralizers.  
(d) FSSAI specifications for milk. (15)

**B.Sc. Dairy Science (Vocational Subject)**  
**III Year V Semester**  
**DSE-IB: Dairy Chemistry**  
**Practical Syllabus (1 Credit)**

1. Estimation of Fat in milk.
2. Estimation of SNF in milk.
3. Estimation of Specific gravity of milk.
4. Estimation of Acidity of milk.
5. Measurement of pH of milk.
6. Measurement of Surface tension of milk.
7. Measurement of Viscosity of milk.
8. Comment on the quality of given milk sample.

**Reference Books:**

1. Dairy Chemistry and Animal Nutrition – M.M. Roy.
2. Text book of Practical Dairy Chemistry – N.K. Roy.
3. Fundamentals of Dairy Chemistry – Webb Johnson and Alfred.
4. Dairy Chemistry and Physics – Pieter Walstra and Robert Jenner.
5. Fundamentals of Dairy Chemistry – Noble P. Wong.
6. A text book of Dairy Chemistry – Ling, E.R.

**B.Sc. III Year  
Semester-V  
Generic Elective**

**GE-1 (2 hrs/week)**

**(2 Credits) Lectures: 30**

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**Entrepreneurship Development**

- Unit-I** Entrepreneurial Development:
- Case studies of Successful Entrepreneurs.
  - Exercises on ways of sensing opportunities – Sources of idea, creating efforts, SWOT Analysis.
  - Entrepreneurial skill assessment test.
  - Techniques of development of entrepreneurial skills, positive self image and locus of control.
- Unit-II** Food Business Management:
- Case studies of Food Processing Business and its aspects.
  - Business opportunity Identification and Assessment Techniques.
  - Business idea generation and evaluation exercise.
  - Market Assessment study; Analysis of competitive situation.
  - SWOT Analysis for business and competitors.
  - Preparation of business plan.
  - Preparation of Project Report.
  - Methods of arrangement of inputs – Finance and Material.

**Recommended Books:**

1. Acharya SS and Agarwal NL “Agricultural Marketing in India”, Oxford and ISH Publishers Co., New Delhi, 1987.
2. Chandra, Prasanna “Projects, Planning, Analysis, Selection, Implementation and Review”, TMH Pub., Co., New Delhi, 1996.
3. David D and Erickson S “Principles of Agribusiness Management” MGH Book Co., New Delhi, 1987.
4. David H. Holt “Entrepreneurship – A new Venture Creation” Prentice Hall of India, New Delhi, 2002.
5. Phillip Kotler “Marketing Management”, PHI Pvt. Ltd., New Delhi, 1994.
6. Vasant Desai “The Dynamics of Entrepreneurial Development and Management” Himalaya Publishing House Pvt. Ltd., Mumbai, 2011.
7. Vasant Desai “Fundamentals of Entrepreneurship and Small Business Management” Himalaya Publishing House Pvt. Ltd., Mumbai, 2012.



**B.Sc. Dairy Science (Vocational Subject)**  
**III Year VI Semester**  
**DSE-IIA: Technology of Dairy Products - II**  
**Theory Syllabus (4 Credits)**

**60 Lectures**

- Unit 1:** Butter: PFA Standards, Classification, Composition, Method of manufacture of butter by Creamery butter method, Overrun in butter. Butter oil: Composition, uses and method of manufacture. (15)
- Unit2:** Cheese: PFA Standards, Composition, Classification, method of manufacture of Cheddar cheese and Cottage cheese. Ice cream: BIS Standards, Composition, Classification, Method of manufacture and Overrun in ice cream. (15)
- Unit3:** Condensed and Evaporated milks: Types of condensed milks, Standards, Composition and method of manufacture. Milk powder: BIS Standards, Types of drying systems, Manufacture of Roller dried and Spray dried milk powder. (15)
- Unit 4:** Indigenous Milk products: Khoa, Channa, Ghee, Dahi and Kulfi: PFA Standards and method of manufacture. (15)

**Note: In-Plant Training** for 2 weeks is compulsory during III year VI semester in any of the Dairy plants where there is facility for making wide range of Dairy products. Students need to submit report at the time of VI Semester Practical Examination. (Weightage of 25% )

**B.Sc. Dairy Science (Vocational Subject)**  
**III Year VI Semester**  
**DSE-IIA: Technology of Dairy Products - II**  
**Practical Syllabus (1 Credit)**

1. Preparation of butter.
2. Preparation of different varieties of ice cream.
3. Preparation of Indigenous milk products like
  - a) Khoa
  - b) Channa
  - c) Paneer
  - d) Kulfi
  - e) Ghee
  - f) Dahi
4. Visit to a Dairy plant to observe preparation of Concentrated milk and Dried milk.

**Reference Books:**

1. Outlines of Dairy Technology – Sukumar De.
2. Milk products preparation and quality control – C.P. Ananthakrishnan.
3. The technology of milk processing – C.P. Ananthakrishnan.
4. Modern Dairy products – Lincoln M. Lampert.
5. Milk and milk products – Eckles, Combs, Harold Macy.

**B.Sc. Dairy Science (Vocational Subject)**

**III Year VI Semester**

**DSE-IIB: Dairy Microbiology**

**Theory Syllabus (4 Credits)**

**60 Lectures**

**Unit 1:** (a) Types of microorganisms present in milk: acid producing, gas producing, protein splitting, fat splitting, pathogenic and inert organisms.

(b) Types of microorganisms based on temperature requirement: Psychrophilic, mesophilic, thermophilic and thermoduric microorganisms. (15)

**Unit 2:** (a) Chemical changes observed during storage of milk and abnormal fermentations observed in milk: Souring, gassy fermentation, proteolysis, lipolysis, ropiness and flavor fermentations.

(b) Sources of contamination of milk and their control: Exterior of the animal, interior of the udder, utensils, water, milker, flies and insects, soil and manure, milking barn, cattle shed and surroundings. (b) Methods of clean milk production. (15)

**Unit 3:** Microbiological examination of milk: Direct microscopic count, Standard plate count, Methylene blue reduction test, Resazurin reduction test and Coliform test. Milk borne diseases: bacterial, viral and other diseases. (15)

**Unit 4:** Cleaning and sanitization of dairy equipment: Desirable properties of detergents and sanitizers; commonly used detergents and sanitizers; Methods of cleaning and sanitization: (i) Hand washing (ii) Mechanical washing (iii) Cleaning in place. (15)

**B.Sc. Dairy Science (Vocational Course)**

**III Year VI Semester**

**DSE-II B: Dairy Microbiology**

**Practical Syllabus (1 Credit)**

1. MBRT test of milk.
2. RRT test of milk.
3. Direct microscopic count of milk.
4. SPC of milk.
5. Coliform count of milk.
6. Thermoduric count of milk.
7. Thermophilic count of milk.
8. Psychrophilic count of milk.
9. Mesophilic count of milk.

**Reference Books:**

1. Dairy Microbiology – R.K. Robinson.
2. Milk products preparation and quality control – C.P. Ananthkrishnan.
3. Food microbiology – W.C. Frazier.



**B.Sc. III Year  
Semester-VI  
Paper 8: Optional**

**GE-II (2 hrs/week)**

**(2 Credits) Lectures: 30**

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**Food Hygiene and Quality Testing**

**Unit I: Introduction to Food Hygiene 15**

- Food hygiene
- Food spoilage
- Food handling
- Special requirements for high-risk foods,
- Safe food cooking temperature and storage techniques.
- Hygiene and Sanitation in Food Service Institutions
- Cleaning and disinfection, Personal hygiene Pest control, Waste disposal

**Unit II: Sensory Methods of Food Quality Testing 15**

- Sensation of taste, smell, appearance and flavor,
- Sensory evaluation techniques
- Objective Methods of Food Quality Testing
- Physical test methods (moisture, acidity, water activity, texture, viscosity, colour)
- Simple methods of chemical analysis (protein, fat, water, ash)
- Microbiological sampling and testing.

**Recommended Books:**

1. Fellows P et al. Making Safe Food: A Guide to Safe Food Handling and Packaging for Small-scale Producers Practical. Action Publishing, 1998.
2. Frazier WC and Westhoff DC. Food Microbiology, TMH, New Delhi, 2004.
3. IFST. Food Hygiene Training: A Guide to its Responsible Management, UK: Institute of Food Science and Technology 1992.
4. Lawley R, Curtis L and Davis J. The Food Safety Hazard Guidebook , RSC Publishing, 2004.
5. Manay NS and Shadakshaswamy M. Food Facts and Principles, New Age International, 2004.
6. Marriott NG and Gravani RB. Principles of Food Sanitation, New York: Springer, 2006.
7. FAO Food and Nutrition Paper – 60. Food Fortification - Technology and Quality Control. 1996.
8. Suri S and Malhotra A. Food Science, Nutrition and Safety, Pearson India Ltd, 2014.

**B.Sc I Yr CHEMISTRY**  
**SEMESTER WISE SYLLABUS**  
**SEMESTER I**  
**Paper - I**  
**Chemistry - I**

**Unit-I (Inorganic Chemistry)**

**15 h (1 hr/week)**

**S1- I-1. Chemical Bonding**

8 h

Ionic solids- lattice and solvation energy, solubility of ionic solids, Fajan's rule, polarity and polarizability of ions. VSPER Theory - Common hybridization- $sp$ ,  $sp^2$ ,  $sp^3$ ,  $sp^3d$ ,  $sp^3d^2$  and  $sp^3d^3$ , shapes of molecules. Molecular orbital theory: Shapes and sign convention of atomic orbitals. Modes of bonds. Criteria for orbital overlap. LCAO concept.  $\pi$  and  $\sigma$  overlapping. Concept of Types of molecular orbitals- bonding, antibonding and non bonding. MOED of homonuclear diatomics -  $H_2$ ,  $N_2$ ,  $O_2^-$ ,  $O_2^{2-}$ ,  $F_2$  (unhybridized diagrams only) and heteronuclear diatomics  $CO$ ,  $CN^-$ ,  $NO$ ,  $NO^+$  and  $HF$ . Bond order, stability and magnetic properties.

**S1-I-2. p-Block Elements 1**

7 h

Group-13: Structure of diborane and higher Boranes ( $B_4H_{10}$  and  $B_5H_9$ ), Boron nitrogen compounds ( $B_3N_3H_6$  and  $BN$ ), Lewis acid nature of  $BX_3$ .  
Group - 14: Carbides-Classification - ionic, covalent, interstitial - Structures and reactivity. Industrial applications. Silicones - Classification - straight chain, cyclic and cross-linked.  
Group - 15: Nitrides - Classification - ionic, covalent and interstitial. Reactivity - hydrolysis. Reactions of hydrazine, hydroxyl amine, phosphazenes.

**Unit - II (Organic Chemistry)**

**15h(1 hr/week)**

**S1-O-1: Structural Theory in Organic Chemistry**

5 h

Bond polarization: Factors influencing the polarization of covalent bonds, electro negativity - inductive effect. Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance - Mesomeric effect, application to (a) acidity of phenol. (b) acidity of carboxylic acids and basicity of anilines. Stability of carbo cations, carbanions and free radicals. Hyper conjugation and its application to stability of carbonium ions, free radicals and alkenes.

**S1-O-2: Acyclic Hydrocarbons**

6 h

**Alkanes**- Methods of preparation: From Grignard reagent, Kolbe synthesis. Chemical reactivity - inert nature, free radical substitution, Halogenation example- reactivity, selectivity and orientation.

**Alkenes** - Preparation of alkenes (with mechanism) (a) by dehydration of alcohols (b) dehydrohalogenation of alkyl halides (c) by dehalogenation of 1,2 dihalides, Zaitsev's rule. Properties: Anti-addition of halogen and its mechanism. Addition of  $HX$ , Markonikov's rule, addition of  $H_2O$ ,  $HOX$ ,  $H_2SO_4$  with mechanism and addition of  $HBr$  in the presence of peroxide (anti - Markonikov's addition). Oxidation (cis - additions) - hydroxylation by  $KMnO_4$ ,  $OsO_4$ ,

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anti addition- peracids (via epoxidation), hydroboration, ozonolysis – location of double bond. Dienes – Types of dienes, reactions of conjugated dienes – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diels – Alder reaction.

**Alkynes**– Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Chemical reactivity – electrophilic addition of  $X_2$ , HX,  $H_2O$  (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids) and reduction (Metal-ammonia reduction, catalytic hydrogenation).

### Aromatic Hydrocarbons

4h

Introduction to aromaticity: Huckel's rule – Benzene, Naphthalene and Anthracene. Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation and halogenation, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. Orientation – (i) activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - nitro, nitrile, carbonyl, carboxylic acid, sulphonic acid and halo groups.

### Unit – III (Physical Chemistry)

15h(1 hr/week)

#### S1-P-1: Atomic structure and elementary quantum mechanics

3 h

Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Limitations of classical mechanics, Compton effect, de Broglie's hypothesis. Heisenberg's uncertainty principle.

#### S1-P-2: Gaseous State

5 h

Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of  $CO_2$ . The van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquifaction of gases: i) Linde's method based on Joule Thomson effect ii) Claude's method based on adiabatic expansion of a gas.

#### S1-P-3: Liquid State and Solutions

4h

##### Liquid State

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

##### Solutions

3h

Liquid - liquid mixtures, ideal liquid mixtures, Raoult's and Henry's laws. Non ideal systems. Azeotropes: HCl- $H_2O$  and  $C_2H_5OH - H_2O$  systems. Fractional distillation. Partially miscible liquids: Phenol – Water, Trimethyl amine – Water and Nicotine – Water systems.

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## Unit - IV (General Chemistry)

15h(1 hr/week)

### S1-G-1. General Principles of Inorganic Qualitative Analysis

6 h

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions-  $CO_3^{2-}$ ,  $Cl^-$ ,  $Br^-$ ,  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $BO_3^{3-}$ ,  $CH_3COO^-$ ,  $NO_3^-$ . Interfering ions. Cation Analysis: Principles involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations ( $Hg_2^{2+}$ ,  $Ag^+$ ,  $Pb^{2+}$ ) with flow chart and chemical equations. Principle involved in separation of group II & IV cations. General discussion for the separation and identification of group II ( $Hg^{2+}$ ,  $Pb^{2+}$ ,  $Bi^{3+}$ ,  $Cd^{2+}$ ,  $Sb^{3+}$ ), III ( $Al^{3+}$ ,  $Fe^{3+}$ ), IV ( $Mn^{2+}$ ,  $Zn^{2+}$ ) individual cations with flow chart and chemical equations. General discussion for the separation and identification of group V individual cations ( $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$ ) with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations ( $Mg^{2+}$ ,  $NH_4^+$ ).

### S1-G-2. Isomerism

5h

**Isomerism:** Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers - definitions and examples. Representation of stereoisomers - Wedge, Fischer projection, Sawhorse, Newmann formulae.

**Conformational analysis :** Classification of stereoisomers based on energy. Definition and examples Conformational and configurational isomers. Conformational analysis of ethane, n-butane, 1,2-dichloroethane, 2-chloroethanol. Cyclic compounds: Baeyer's strain theory, Conformational analysis of cyclohexane

Cis-trans isomerism: E-Z-Nomenclature

### S1-G-3: Solid state Chemistry

4 h

Laws of Crystallography: (i) Law of Constancy of interfacial angles (ii) Law of Symmetry-Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems (a brief review). X-ray diffraction by crystals; Derivation of Bragg's equation. Determination of structure of NaCl, KCl and CsCl (Bragg's method and Powder method).

## References

**General reference:** B.Sc I Year Chemistry : Semester I, Telugu Academy publication, Hyd  
Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn.
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn Wiley Publishers 2001. Chem.

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5. Inorganic Chemistry Principles of structure and reactivity by James E. Huhey, E.A. Keiter and R.L. Keiter 4th edn.
6. Chemistry of the elements by N.N. Greenwood and A. Earnshaw Pergamon Press 1989.
7. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press 1999.
9. Textbook of Inorganic Chemistry by R Gopalan.

#### Unit- II

1. Organic Chemistry by Morrison and Boyd.
2. Organic Chemistry by Graham Solomons.
3. Organic Chemistry by Bruice Yuranis Powla.
4. Organic Chemistry by L. G. Wade Jr.
5. Organic Chemistry by M. Jones, Jr
6. Organic Chemistry by John McMurry.
7. Organic Chemistry by Soni.
8. General Organic chemistry by Sachin Kumar Ghosh.
9. Organic Chemistry by C N pillai

#### Unit III

1. Principles of physical chemistry by Prutton and Marron.
2. Text Book of Physical Chemistry by Soni and Dharmahara..
3. Text Book of Physical Chemistry by Puri and Sharma.
4. Text Book of Physical Chemistry by K. L. Kapoor.
5. Physical Chemistry through problems by S.K. Dogra.
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry by Lewis Glasstone.

#### Unit IV

1. Qualitative analysis by Welcher and Hahn.
2. Vogel's Qualitative Inorganic Analysis by Svehla.
3. Text Book of Organic Chemistry by Morrison And Boyd.
4. Text Book of Organic Chemistry by Graham Solomons.
5. Text Book of Organic Chemistry by Bruice Yuranis Powla.
6. Text Book of Organic Chemistry by Soni.
7. Text Book of Physical Chemistry by Soni And Dharmahara..
8. Text Book of Physical Chemistry by Puri And Sharma.
9. Text Book of Physical Chemistry by K. L. Kapoor.

### Laboratory Course

45h (3 h / week)

#### Paper I - Qualitative Analysis - Semi micro analysis of mixtures

Analysis of two anions (one simple, one interfering) and two cations in the given mixture.

Anions:  $CO_3^{2-}$ ,  $SO_3^{2-}$ ,  $S^{2-}$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $CH_3COO^-$ ,  $NO_3^-$ ,  $PO_4^{3-}$ ,  $BO_3^{3-}$ ,  $SO_4^{2-}$  . .

Cations:  $Hg_2^{2+}$ ,  $Ag^+$ ,  $Pb^{2+}$

$Hg^{2+}$ ,  $Pb^{2+}$ ,  $Bi^{3+}$ ,  $Cd^{2+}$ ,  $Cu^{2+}$ ,  $As^{3+/5+}$ ,  $Sb^{3+/5+}$ ,  $Sn^{2+/4+}$

$Al^{3+}$ ,  $Cr^{3+}$ ,  $Fe^{3+}$

$Zn^{2+}$ ,  $Ni^{2+}$ ,  $Co^{2+}$ ,  $Mn^{2+}$

$Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$

$Mg^{2+}$ ,  $NH_4^+$

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**B.Sc I Yr CHEMISTRY**  
**SEMESTER WISE SYLLABUS**  
**SEMESTER II**  
**Paper – II**  
**Chemistry – II**

**Unit-I ( Inorganic Chemistry)**

**15 h (1 hr/week)**

**S2-I-1 p-block Elements -II**

**7 h**

**Oxides:** Types of oxides (a) Normal- acidic, basic amphoteric and neutral (b) Mixed (c) sub oxide d) peroxide e) superoxide. Structure of oxides of C, N, P, S and Cl - reactivity, thermal stability, hydrolysis.

**Oxy acids:** Structure and acidic nature of oxyacids of B, C, N, P, S, Cl and I. Redox properties of oxyacids of Nitrogen:  $\text{HNO}_2$  (reaction with  $\text{FeSO}_4$ ,  $\text{KMnO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ),  $\text{HNO}_3$  (reaction with  $\text{H}_2\text{S}$ , Cu),  $\text{HNO}_4$  (reaction with KBr, Aniline),  $\text{H}_2\text{N}_2\text{O}_2$  (reaction with  $\text{KMnO}_4$ ). Redox properties of oxyacids of Phosphorus:  $\text{H}_3\text{PO}_2$  (reaction with  $\text{HgCl}_2$ ),  $\text{H}_3\text{PO}_3$  (reaction with  $\text{AgNO}_3$ ,  $\text{CuSO}_4$ ). Redox properties of oxyacids of Sulphur:  $\text{H}_2\text{SO}_3$  (reaction with Cu, Au),  $\text{H}_2\text{SO}_5$  (reaction with KI,  $\text{FeSO}_4$ ),  $\text{H}_2\text{S}_2\text{O}_8$  (reaction with  $\text{FeSO}_4$ , KI). Redox properties of oxy acids of Chlorine.

**Interhalogens-** Classification- general preparation- structures of AB, AB<sub>3</sub>, AB<sub>5</sub> and AB<sub>7</sub> type and reactivity.

**Poly halides-** Definition and structure of  $\text{ICl}_2^-$ ,  $\text{ICl}_4^-$  and  $\text{I}_3$ .

**Pseudohalogens:** Comparison with halogens.

**S2-I-2: Chemistry of Zero group elements**

**2 h**

Isolation of noble gases, Structure, bonding and reactivity of Xenon compounds – Oxides, Halides and Oxy-halides. Clathrate compounds and Anomalous behavior of He (II)

**S2-I-3: Chemistry of d-block elements**

**6 h**

Characteristics of d-block elements with special reference to electronic configuration, variable valence, ability to form complexes, magnetic properties & catalytic properties. Stability of various oxidation states and standard reduction potentials. Comparative treatment of second and third transition series with their 3d analogues. Study of Ti, Cr and Cu triads. Titanium triad – electronic configuration and reactivity of +3 and +4 states – oxides and halides. Chromium triad – reactivity of +3 and +6 states. Copper triad – reactivity of +1, +2 and +3 states.

**Unit - II (Organic Chemistry)**

**15h(1 hr/week)**

**S2-O-1: Halogen compounds**

**4 hrs**

Classification: alkyl (primary, secondary, tertiary), aryl, aralkyl, allyl, vinyl, benzyl. Chemical reactivity - reduction, formation of  $\text{RMgX}$ , Nucleophilic substitution reactions – classification into  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$ . Mechanism and energy profile diagrams of  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$  reactions. Stereochemistry of  $\text{S}_{\text{N}}2$  (Walden Inversion) 2-bromobutane,  $\text{S}_{\text{N}}1$  (Racemisation) 1-bromo-1-phenylpropane Structure and reactivity – Ease of hydrolysis - comparison of alkyl, vinyl, allyl, aryl, and benzyl halides.

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## Unit - IV (General Chemistry)

15h(1 hr/week)

### S1-G-1. General Principles of Inorganic Qualitative Analysis

6 h

Anion analysis: Theory of sodium carbonate extract, classification and reactions of anions-  $CO_3^{2-}$ ,  $Cl^-$ ,  $Br^-$ ,  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $BO_3^{3-}$ ,  $CH_3COO^-$ ,  $NO_3^-$ . Interfering ions. Cation Analysis: Principles involved - Solubility product, common ion effect, general discussion for the separation and identification of group I individual cations ( $Hg_2^{2+}$ ,  $Ag^+$ ,  $Pb^{2+}$ ) with flow chart and chemical equations. Principle involved in separation of group II & IV cations. General discussion for the separation and identification of group II ( $Hg^{2+}$ ,  $Pb^{2+}$ ,  $Bi^{3+}$ ,  $Cd^{2+}$ ,  $Sb^{3+}$ ), III ( $Al^{3+}$ ,  $Fe^{3+}$ ), IV ( $Mn^{2+}$ ,  $Zn^{2+}$ ) individual cations with flow chart and chemical equations. General discussion for the separation and identification of group V individual cations ( $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$ ) with flow chart and chemical equations. Theory of flame test. Identification of Group VI cations ( $Mg^{2+}$ ,  $NH_4^+$ ).

### S1-G-2. Isomerism

5h

**Isomerism:** Definition of isomers. Classification of isomers: Constitutional and Stereoisomers - definition and examples. Constitutional isomers: chain, functional and positional isomers. Stereoisomers: enantiomers and diastereomers - definitions and examples. Representation of stereoisomers - Wedge, Fischer projection, Sawhorse, Newmann formulae.

**Conformational analysis :** Classification of stereoisomers based on energy. Definition and examples Conformational and configurational isomers. Conformational analysis of ethane, n-butane, 1,2- dichloroethane, 2-chloroethanol .Cyclic compounds: Baeyer's strain theory, Conformational analysis of cyclohexane

Cis-trans isomerism: E-Z-Nomenclature

### S1-G-3: Solid state Chemistry

4 h

Laws of Crystallography: (i) Law of Constancy of interfacial angles (ii) Law of Symmetry- Symmetry elements in crystals (iii) Law of rationality of indices. Definition of space lattice, unit cell. Bravais Lattices and Seven Crystal systems (a brief review). X-ray diffraction by crystals; Derivation of Bragg's equation. Determination of structure of NaCl, KCl and CsCl (Bragg's method and Powder method).

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anti addition- peracids (via epoxidation), hydroboration, ozonolysis – location of double bond. Dienes – Types of dienes, reactions of conjugated dienes – 1,2 and 1,4 addition of HBr to 1,3 – butadiene and Diels – Alder reaction.

**Alkynes**– Preparation by dehydrohalogenation of vicinal dihalides, dehalogenation of tetrahalides. Physical Properties: Chemical reactivity – electrophilic addition of  $X_2$ , HX,  $H_2O$  (tautomerism), Oxidation (formation of enediol, 1,2 diones and carboxylic acids) and reduction (Metal-ammonia reduction, catalytic hydrogenation).

### Aromatic Hydrocarbons

4h

Introduction to aromaticity: Huckel's rule – Benzene, Naphthalene and Anthracene. Reactions - General mechanism of electrophilic substitution, mechanism of nitration, sulphonation and halogenation, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution - Definition of ortho, para, and meta directing groups. Ring activating and deactivating groups with examples. Orientation – (i) activating groups: Amino, methoxy and alkyl groups. (ii) Deactivating groups - nitro, nitrile, carbonyl, carboxylic acid, sulphonic acid and halo groups.

### Unit – III (Physical Chemistry)

15h(1 hr/week)

#### S1-P-1: Atomic structure and elementary quantum mechanics

3 h

Black body radiation, heat capacities of solids, Rayleigh Jeans law, Planck's radiation law, photoelectric effect, Limitations of classical mechanics, Compton effect, de Broglie's hypothesis. Heisenberg's uncertainty principle.

#### S1-P-2: Gaseous State

5 h

Deviation of real gases from ideal behavior. van der Waals equation of state. Critical phenomenon. PV isotherms of real gases, continuity of state. Andrew's isotherms of  $CO_2$ . The van der Waal's equation and critical state. Derivation of relationship between critical constants and van der Waal's constants. The law of corresponding states, reduced equation of states. Joule Thomson effect and inversion temperature of a gas. Liquefaction of gases: i) Linde's method based on Joule Thomson effect ii) Claude's method based on adiabatic expansion of a gas.

#### S1-P-3: Liquid State and Solutions

4h

##### Liquid State

Intermolecular forces, structure of liquids (qualitative description). Structural differences between solids, liquids and gases. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).

##### Solutions

3h

Liquid - liquid mixtures, ideal liquid mixtures, Raoult's and Henry's laws. Non ideal systems. Azeotropes: HCl- $H_2O$  and  $C_2H_5OH - H_2O$  systems. Fractional distillation. Partially miscible liquids: Phenol – Water, Trimethyl amine – Water and Nicotine – Water systems.

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## S2-O-2: Hydroxy compounds and ethers

6 hrs

**Alcohols:** Preparation: 1°, 2° and 3° alcohols using Grignard reagent, Reduction of Carbonyl compounds, carboxylic acids and esters. Physical properties: H-bonding, Boiling point and Solubility. Reactions with Sodium, HX/ZnCl<sub>2</sub> (Lucas reagent), esterification, oxidation with PCC, alk. KMnO<sub>4</sub>, acidic dichromates, conc. HNO<sub>3</sub> and Oppenauer oxidation (Mechanism).

**Phenols:** Preparation: (i) from diazonium salts of anilines, (ii) from benzene sulphonic acids and (iii) Cumene hydroperoxide.

Properties: Acidic nature, formation of phenoxide and reaction with R-X, electrophilic substitution; halogenations, Reimer Tiemann reaction (Mechanism), Kolbe reaction (Mechanism), Gattermann-Koch reaction, Azo-coupling reaction, Schotten-Boumann reaction, Houben-Hoesch condensation, .

Ethers : Nomenclature, preparation by (a) Williamson's synthesis (b) from alkenes by the action of conc. H<sub>2</sub>SO<sub>4</sub>. Physical properties – Absence of Hydrogen bonding, insoluble in water, low boiling point. Chemical properties – inert nature, action of conc. H<sub>2</sub>SO<sub>4</sub> and HI.

## S2-O-3 Carbonyl compounds

5h

Preparation of aldehydes & ketones from acid chloride, 1,3-dithianes, nitriles and from carboxylic acids. Special methods of preparing aromatic aldehydes and ketones by (a) Oxidation of arenes (b) Hydrolysis of benzal halides Physical properties – absence of Hydrogen bonding. Reactivity of the carbonyl groups in aldehydes and ketones. Chemical reactivity: Addition of (a) NaHSO<sub>3</sub> (b) HCN (c) RMgX (d) NH<sub>3</sub> (e) RNH<sub>2</sub> (f) NH<sub>2</sub>OH (g) PhNHNH<sub>2</sub> (h) 2,4-DNP (Schiff bases). Addition of H<sub>2</sub>O to form hydrate, chloral hydrate (stable), addition of alcohols - hemiacetal and acetal formation. Cannizzaro reaction. Oxidation reactions – KMnO<sub>4</sub> oxidation and auto oxidation, reduction – catalytic hydrogenation, mechanism of Clemmenson's reduction, Wolf-kishner reduction, Meerwein Ponnoff Verly reduction. Reduction with LAH, NaBH<sub>4</sub>.

## Unit - III (Physical Chemistry)

15h(1 hr/week)

### S2-P-1: Electrochemistry

15 h

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kohlrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law - its uses and limitations. Debye-Huckel-Onsager's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of dissociation, determination of K<sub>a</sub> of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations.

Electrolytic and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells. Electro motive force (EMF) of a cell and its measurement. Computation of EMF. Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble

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salt and redox electrodes. Electrode reactions, Nernst equation, cell EMF and Single electrode potential, Standard Hydrogen electrode – reference electrodes (calomel electrode) – standard electrode potential, sign conventions, electrochemical series and its significance. Applications of EMF measurements. Calculation of thermodynamic quantities of cell reactions (Gibbs free energy  $G$ , Helmholtz free energy and Equilibrium constant  $K$ ). Determination of pH using hydrogen electrode, glass electrode and quinhydrone electrode. Solubility product of AgCl. Potentiometric titrations.

## Unit – IV (General Chemistry)

15 h (1 hr/week)

### S2-G-1: Theory of Quantitative Analysis

6 hours

**Volumetric Analysis:** Introduction, standard solutions, indicators, end point, titration curves, Types of titrations: i) neutralization titration- principle, theory of acid base indicators, titration curves and selection of indicators- strong acid - strong base, strong acid –weak base, weak acid-strong base and weak acid –weak base. Theory of redox titrations - internal(KMnO<sub>4</sub>) and external indicators – use of diphenylamine and ferroin indicators. Theory of complexometric titrations – use of EBT, Murexide and Fast sulphone black indicators. Role of pH in complexometric titrations. Precipitation titrations – theory of adsorption indicators.

**Gravimetric analysis-** Introduction, nucleation, precipitation, growth of precipitate, filtration and washing, drying and incineration of precipitate, coprecipitation and post precipitation. Determination of Ni<sup>2+</sup>

### S2-G-2: Stereoisomerism

5h

**Optical activity:** Definition, wave nature of light, plane polarised light, optical rotation and specific rotation, chiral centers. Chiral molecules: definition and criteria - absence of plane, center and S<sub>n</sub> axis of symmetry – asymmetric and dissymmetric molecules. Examples of asymmetric molecules (Glyceraldehyde, Lactic acid, Alanine) and dissymmetric molecules (trans-1,2-dichlorocyclopropane). Molecules with constitutionally symmetrical chiral carbons (Tartaric acid) Molecules with constitutionally unsymmetrical chiral carbons (2,3dibromopentane). D, L configuration – examples. R, S – configuration: Cahn-Ingold-Prelog rules, examples for asymmetric and dissymmetric molecules.

### S2-G-3: Dilute Solutions & Colligative Properties

4 h

Dilute Solutions, Colligative Properties, Raoult's law, relative lowering of vapour pressure, molecular weight determination. Osmosis - laws of osmotic pressure, its measurement, determination of molecular weight from osmotic pressure. Elevation of boiling point and depression of freezing point. Derivation of relation between molecular weight and elevation in boiling point and depression in freezing point.

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**General reference:** B.Sc I Year Chemistry : Semester II, Telugu Academy publication, Hyd

### Unit I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications 1996.
2. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn.
3. Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers 2001.
4. Chemistry of the elements by N.N. Greenwood and A. Earnshaw Pergamon Press 1989.
5. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press 1999.
6. Inorganic Chemistry Principles of structure and reactivity by James E. Huhey, E.A. Keiter and R.L. Keiter 4<sup>th</sup> Edn.
7. Textbook of inorganic chemistry by R Gopalan.

### Unit II

1. Organic Chemistry by Morrison and Boyd.
2. Organic Chemistry by Graham Solomons.
3. Organic Chemistry by Bruce Yuranis Powla.
4. Organic Chemistry by L. G. Wade Jr.
5. Organic Chemistry by M. Jones, Jr
6. Organic Chemistry by John McMurry.
7. Organic Chemistry by Soni.
8. General Organic chemistry by Sachin Kumar Ghosh.
9. Organic Chemistry by C N pillai

### Unit III

1. Physical chemistry by P W Atkins
2. Principles of physical chemistry by Prutton and Marron.
3. Text Book of Physical Chemistry by Soni and Dharmahara.
4. Text Book of Physical Chemistry by Puri and Sharma
5. Text Book of Physical Chemistry by K. L. Kapoor
6. Physical Chemistry through problems by S.K. Dogra.
7. Elements of Physical Chemistry by Lewis and Glasstone.
8. Material science by Kakani & Kakani

### Unit IV

1. Vogel's Text Book of Quantitative Analysis by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney 5<sup>th</sup> edn Addison Wesley Longman Inc. 1999.
2. Quantitative Analysis by Day and Underwood Prentice Hall (India) VI Edn..
3. Nano: The Essentials by T. Pradeep, McGraw-Hill Education.
4. Chemistry of nanomaterials: Synthesis, Properties and applications by CNR Rao et.al.
5. Nanostructured Materials and Nanotechnology, edited by Hari Singh Nalwa, Academic Press
6. Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati.

## Laboratory Course

45hrs (3 h / week)

### Paper II- Quantitative Analysis

#### Acid - Base titrations

1. Estimation of Carbonate in Washing Soda.
2. Estimation of Bicarbonate in Baking Soda.
3. Estimation of Carbonate and Bicarbonate in the Mixture.

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**KAKATIYA UNIVERSITY - WARANGAL - TELANGANA**  
Under Graduate Courses (Under CBCS 2019–2022)  
**B.Sc. CHEMISTRY II Year**  
**SEMESTER – III**

Paper-III  
Chemistry - III

**Unit-I (Inorganic Chemistry)**

**15 h (1 hr/week)**

**S3-I-1: Chemistry of f-block elements:**

**5 h**

Chemistry of Lanthanides: Position in periodic table, Electronic structure, oxidation state, ionic and atomic radii- lanthanide contraction- cause and consequences, anomalous behavior of post lanthanides-complexation- type of donor ligands preferred. Magnetic properties- paramagnetism. Colour and spectra, f-f transitions –occurrence and separation– ion exchange method, solvent extraction.

Chemistry of actinides- general features – electronic configuration, oxidation state, actinide contraction, colour and complex formation. Comparison with lanthanides.

**S3-I-2: Coordination Compounds-I**

**6 h**

Simple inorganic molecules and coordination complexes. Nomenclature – IUPAC rules, 1. Coordination number, coordination geometries of metal ions, types of ligands. 2. Brief review of Werner's theory, Sidgwick's electronic interpretation and EAN rule and their limitations. (Valence bond theory (VBT) – postulates and application to (a) tetrahedral complexes  $[\text{Ni}(\text{NH}_3)_4]^{2+}$ ,  $[\text{NiCl}_4]^{2-}$  and  $[\text{Ni}(\text{CO})_4]$  (b) Square planar complexes  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{Cu}(\text{NH}_3)_4]^{2+}$ ,  $[\text{PtCl}_4]^{2-}$  (c) Octahedral complexes  $[\text{Fe}(\text{CN})_6]^{4-}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$ ,  $[\text{FeF}_6]^{4-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$ ,  $[\text{CoF}_6]^{3-}$ . Limitations of VBT. 3. Isomerism in coordination compounds, stereo isomerism – (a) geometrical isomerism in (i) square planar meta l complexes of the type  $[\text{MA}_2\text{B}_2]$ ,  $[\text{MA}_2\text{BC}]$ ,  $[\text{M}(\text{AB})_2]$ ,  $[\text{MABCD}]$ . (ii) Octahedral metal complexes of the type  $[\text{MA}_4\text{B}_2]$ ,  $[\text{M}(\text{AA})_2\text{B}_2]$ ,  $[\text{MA}_3\text{B}_3]$  using suitable examples, (b) Optical isomerism in (i). tetrahedral complexes  $[\text{MABCD}]$ , (ii). Octahedral complexes  $[\text{M}(\text{AA})_2\text{B}_2]$ ,  $[\text{M}(\text{AA})_3]$  using suitable examples. Structural isomerism: ionization, linkage, coordination ligand isomerism using suitable examples.

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**S3-I-3: Metal carbonyls and Organometallic Chemistry****4 h**

Metal carbonyls: Preparation and properties of Ni(CO)<sub>4</sub>. Structural features of Ni(CO)<sub>4</sub>, Fe(CO)<sub>5</sub>, Fe<sub>2</sub>(CO)<sub>9</sub>, Fe<sub>3</sub>(CO)<sub>12</sub> and Cr(CO)<sub>6</sub> -18 valence electron rule.

Definition, nomenclature and classification of organometallic compounds. Methods of preparation, properties and applications of alkyl and aryl compounds of Li, Mg & Al.

**Unit - II (Organic Chemistry)****15h(1 hr/week)****S3-O-1: Carboxylic acids and derivatives****5 h**

Preparation: a) Hydrolysis of Nitriles, amides and esters. b) Carbonation of Grignard reagents. Special methods of preparation of Aromatic Acids - Oxidation of Arenes. Physical properties- hydrogen bonding, dimeric association,. Chemical properties – Reactions involving H, OH and COOH groups -salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation. Reduction of acid to the corresponding primary alcohol - via ester or acid chloride. Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation). Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction. Carboxylic acid Derivatives – Hydrolysis and Amonolysis of acid halides, Acid anhydrides and esters (mechanism of ester hydrolysis by base and acid). Hydrolysis and dehydration of amides.

**S3-O-2: Nitrohydrocarbons****3 h**

Preparation of Nitroalkanes. Reactivity - halogenation, reaction with HNO<sub>2</sub> (Nitrous acid), Nef reaction, reduction. Aromatic Nitrohydrocarbons: Preparation of Nitrobenzene by Nitration. Physical properties, chemical reactivity –Reduction of Nitrobenzenes in different media.

**S3-O-3: Amines, Cyanides and Isocyanides****7 h**

Amines: classification into 1°, 2°, 3° Amines and Quarternary ammonium compounds. Preparative methods – Ammonolysis of alkyl halides, Gabriel synthesis, Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction. Physical properties. Use of amine salts as phase transfer catalysts. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3° Amines, diazotisation. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)- Sandmeyer and Gatterman reaction, by fluorine (Schiemann's reaction), by iodine, CN, NO<sub>2</sub>, H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.

**Cyanides and isocyanides:** Structure. Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes. Preparation of isocyanides from Alkyl halides and Amines. Properties of cyanides and isocyanides, a) hydrolysis b) addition of Grignard reagent iii)

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reduction iv) oxidation.

### Unit III (Physical Chemistry)

15 h (1 hr/week)

#### S3-P-1: Thermodynamics -I

10 h

A brief review of - Energy, work and heat units, mechanical equivalent of heat, definition of system, surroundings. First law of thermodynamics statement- various forms mathematical expression. Thermodynamic quantities- extensive properties and intensive properties, state function and path functions. Energy as a state function and exact differential. Work of expansion and heat absorbed as path function.

Expression for work of expansion, sign convention problems on first law. Heat changes at constant pressure and heat changes at constant volume. Enthalpy. Heat capacities at constant pressure and constant volume. Derivation of  $C_p - C_v = R$ . Isothermal adiabatic processes. Reversible and irreversible processes. Reversible change and maximum work. Derivation of expression for maximum work for isothermal reversible process. Problems. Internal energy of an ideal gas. Joules experiment. Joule-Thompson coefficient. Adiabatic changes in ideal gas, derivation of equation,  $PV^\gamma = \text{constant}$ . P-V curves for isothermal and adiabatic processes. Heat of a reaction at constant volume and at constant pressure, relation between  $\Delta H$  and  $\Delta V$ .

Variation of heat of reaction with temperature. Kirchhoff's equation and problems. Limitations of first law and need for second law. Statement of second law of thermodynamics. Cyclic process. Heat engine, Carnot's theorem, Carnot's cycle. Derivation of efficiency of heat engine. Problems. Thermodynamic scale of temperature.

#### S3-P-2: Thermodynamics-II

5 h

Entropy: Definition from Carnot's cycle. Entropy as a state function. Entropy as a measure of disorder. Sign of entropy change for spontaneous and non-spontaneous processes & equilibrium processes. Entropy changes in i). Reversible isothermal process, ii). Reversible adiabatic process, iii). Phase change, iv). Reversible change of state of an ideal gas. Problems. Entropy of mixing of ideal gases. Free energy Gibbs's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and maximum  $\Delta G$  as Criteria for spontaneity. Derivation of equation  $\Delta G = \Delta H - T\Delta S$ . Significance of the equation. Gibbs equations and Maxwell relations. Variation of G with P, V and T.

### Unit - IV (General Chemistry)

15 h (1 hr/week)

#### S3-G-1 Evaluation of analytical data

4 h

Significant figures, accuracy and precision. Errors-classification of errors- determinate and indeterminate errors, absolute and relative errors. Problems based on mean, median, range, standard deviation

#### S3-G-2: Carbanions-I

5 h

Introduction, acidic nature of  $\alpha$ -hydrogens and tautomerism in carbonyl compounds, nitro hydrocarbons, ethyl acetoacetate, diethyl malonate. Terminal alkynes. Stability of carbanions Reactions : Aldol reaction, Perkin reaction, Benzoin condensation, haloform reaction, conversion of smaller alkynes to higher alkynes.

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### S3-G-3: Phase Rule

6 h

Statement and meaning of the terms – Phase, Component and Degrees of freedom, Gibb's Phase rule, phase equilibria of one component system – water system. Phase equilibria of two-component system – Solid-Liquid equilibria, simple eutectic –Pb-Ag system, desilverisation of lead. Solid solutions – compound with congruent melting point – Mg-Zn system and incongruent melting point – NaCl-H<sub>2</sub>O system.

### References

**General reference:** B.Sc II Year Chemistry : Semester III, Telugu Academy publication, Hyd  
**Unit- I**

1. Analytical chemistry by G. L. David Krupadanam, D. Vijaya Prasad, K. Varaprasada Rao, K.L.N. Reddy and C. Sudhakar
2. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
3. Concise Inorganic Chemistry by J.D. Lee 3<sup>rd</sup> edn Van Nostrand Reinhold Company(1977)
4. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3<sup>rd</sup> edn Wiley Publishers (2001).
5. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey, E.A. Keiter and R.L. Keiter 4<sup>th</sup> edn. (2006)
6. Chemistry of the elements by N.N.Greenwood and A. Earnshaw Pergamon Press(1989).
7. Inorganic Chemistry by Shriver and Atkins 3<sup>rd</sup> edn Oxford Press (1999).
8. Textbook of Inorganic Chemistry by R Gopalan(Universities Press(2012)
9. College Practical chemistry by V K Ahluwalia, Sunitha Dhingra and Adarsh Gulati Universities Press (India) Limited(2012)

### Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninth edition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers Pvt Ltd (2008).
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by Bruice Yuranis Powla. (2012)
6. Text book of organic chemistry by C N pillai CRC Press (2012)
7. Organic Chemistry by L. G. Wade Jr.
8. Organic Chemistry by M. Jones, Jr
9. Organic Chemistry by John McMurry.

### Unit III

1. Principles of physical chemistry by Prutton and Marron. The MacmillanCompany; 4<sup>th</sup> Edn.(1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand and Sons.(2011)
3. Text Book of Physical Chemistry by Puri and Sharma. S. Nagin chand and Co.(2017)
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Colloidal and surface chemistry , M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal and M.S.sethi, Discovery Publishing Pvt.Ltd (2014)
7. Material science by Kakani & Kakani, New Age International(2016)
8. Physical Chemistry by Ira Levine (Author) McGraw-Hill Education; 6 edition (May 9, 2008)

### Unit IV

1. Text book of organic chemistry by Morrison and Boyd, Person(2009)

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2. Text book of organic chemistry by Graham solomons, Wiley(2015)
3. Text book of organic chemistry by Sony, Sultan Chand & Sons; 29<sup>th</sup> edition (2012)
4. Text book of organic chemistry by Bruice yuranis Powla, (2012)
5. General Organic chemistry by Sachin kumar Ghosh, New Age Publishers Pvt Ltd (2008)

### Laboratory Course

#### Paper III (Organic Synthesis)

45 h (3h/week)

#### 1. Synthesis of Organic compounds:

Acetylation: Acetylation of salicylic acid, Benzoylation of Aniline.

Aromatic electrophilic substitution: Nitration: Preparation of nitro benzene and m-dinitro benzene.

Halogenation: Preparation of p-bromo acetanilide, Preparation of 2,4,6-tribromo phenol

Oxidation: Preparation of benzoic acid from benzyl chloride.

Esterification: Preparation of n-butyl acetate from acetic acid.

Methylation: Preparation of - naphthyl methyl ether.

Condensation: Preparation of benzilidene aniline and Benzaldehyde and aniline.

Diazotisation: Azocoupling of  $\beta$ -Naphthol.

#### 2. Microwave assisted synthesis of Asprin – DEMO (demonstration only)

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**B.Sc., III YEAR CHEMISTRY**  
**SEMESTER- VI**  
**DSC-3F: CHEMISTRY PAPER – VI**  
**(04 Credits) 60 Hrs (04 Hrs/week)**

**UNIT-I: SEPARATION TECHNIQUES**

**15 Hrs**

**Solvent Extraction-** Principle, Methods of extraction: Batch extraction, continuous extraction and counter current extraction. Application– Determination of Iron (III).

**Chromatography:** Classification of chromatographic methods, principles of differential migration, adsorption phenomenon, nature of adsorbents, solvent systems.

**Thin layer Chromatography (TLC):** Advantages, preparation of plates, development of the chromatogram, Detection of the spots, factors effecting R<sub>f</sub> values and applications.

**Paper Chromatography:** Principle, choice of paper and solvent systems, development of chromatogram – ascending, descending, radial and two dimensional chromatography and applications.

**Column Chromatography-** Principle, Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

**Gas Chromatography:** Theory and instrumentation (Block diagram), Types of stationary phases and carrier gases (mobile phase).

**UNIT-II: DRUGS AND GREEN CHEMISTRY**

**15 Hrs**

a) **Drugs: Introduction:** Drug, Disease (definition), Historical evolution, Sources-plant, animal synthetic, Biotechnology and human gene therapy.

**Terminology:** Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors-brief treatment) Metabolites and Anti metabolites.

**Nomenclature:** Chemical name, Generic name and trade names with examples.

**Classification:** Classification based on structures and therapeutic activity with one example each.

**Synthesis:** Synthesis and therapeutic activity of the following drugs- L-Dopa, Chloroquin, Omeprazole, Albuterol and Ciprofloxacin.

b) **Green Chemistry: Introduction:** Definition of green chemistry, need of green chemistry, basic principles of green chemistry.

**Green synthesis:** Evaluation of the type of the reaction (i) Rearrangements (100% atom economic), (ii) Addition reaction (100% atom economic), Pericyclic reactions (no by-product)

**Selection of solvent:** Aqueous phase reactions, Reactions in ionic liquids, Solid supported synthesis and solvent free reactions (solid phase reactions) **Green Catalysts:** Phase transfer catalysts (PTC), Biocatalysts.

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### UNIT-III: ELECTRO ANALYTICAL METHODS

15 Hrs

**Potentiometry:** Principle, Electrochemical cell, Electrodes- (i) Indicator and (ii) Reference electrodes – Normal Hydrogen Electrode, Quinhydrone Electrode, Saturated Calomel Electrode. Numerical Problems. Application of Potentiometry – Assay of Sulphanilamide

**Conductometry:** Conductivity Cell, Specific Conductivity, Equivalent Conductivity. Numerical Problems. Applications of Conductometry. Estimation of Cl<sup>-</sup> using AgNO<sub>3</sub>, Determination of Aspirin with KOH.

**Colorimetry:** General features of absorption – spectroscopy, transmittance, absorbance, and molar absorptivity. Beer -Lambert's law and its limitations. Verification of Beer's law. Estimation of iron in water samples by thiocyanate method. Estimation of (i) Chromium and (ii) Manganese in steel.

**Spectrophotometry:** Instruments – Single and Double beam UV- Visible Spectrophotometers, IR-Spectrophotometer- Principle, Sources of radiations, Sampling, Block diagram of FT-IR Spectrophotometer.

### UNIT-IV: MOLECULAR SPECTROSCOPY

15Hrs

Introduction to electromagnetic radiation, interaction of electromagnetic rations with molecules, various types of molecular spectra.

**Electronic spectroscopy:** Bonding and anti-bonding molecular orbitals, electronic energy levels of molecules ( $\sigma$ ,  $\pi$ ,  $n$ ), types of electronic transitions:  $\sigma\text{-}\sigma^*$ ,  $n\text{-}\sigma^*$ ,  $n\text{-}\pi^*$ ,  $\pi\text{-}\pi^*$  with suitable examples. Selection rules, Terminology of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption of characteristics of chromophones: diene, enone and aromatic chromophores. Representation of UV-Visible spectra.

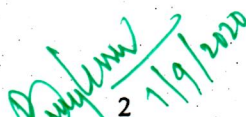
**Infra red spectroscopy:** Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum.

**Proton Magnetic Resonance Spectroscopy (<sup>1</sup>H-NMR):** Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations. <sup>1</sup>H NMR spectrum of – ethyl bromide, acetaldehyde, 1, 1, 2- tri bromo ethane, ethyl acetate and acetophenone.

**Mass Spectrometry:** Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular weight, Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

  
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## REFERENCES:

### Unit-I

1. Analytical Chemistry by David Krupadanam, Universities Press (India) Limited.
2. D. A. Skoog, D.M. West, F.J. Holler, Fundamentals of Analytical Chemistry 6<sup>th</sup> Edn. Saunders College Publishing, Fort worth (1992).
3. M.N Sastry, Separation Methods, Paperback (2004), Himalaya Publications.
4. Usharani Analytical Chemistry Paperback (2000) Narosa Publications.
5. Analytical Chemistry 7<sup>th</sup> edition by Gary D. Christian (2004).

### Unit-II:

1. Drugs by G.L.David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K.L.N.Reddy C.Sudhakar, Universities Press (India) Limited 2007.
2. An Introduction to Medicinal Chemistry by Graham L. Patrick, Oxford University Press, New York. 1995.
3. David William and Thomas Lemke, Foye's Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 2008.
4. Ashutosh Kar Medicinal Chemistry, New Age International, 2005.
5. O.D.Tyagi & M.Yadav Synthetic Drugs by, Anmol Publications, 1998.
6. Medicinal Chemistry by Alka L. Gupta, Pragati Prakashan.
7. Ahluwalia, V.K. & Kidwai, M.R. New Trends in Green Chemistry, Anamalaaya Publishers (2005).
8. Anastas, P.T. & Warner, J.K.: Green Chemistry - Theory and Practical, Oxford University Press (1998).
9. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001) Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).

### Unit-III:

1. Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc, New York (1995).
2. B. K. Sharma, Industrial Chemistry (including Chemical Engineering). Edn. (1997).
3. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis. 7<sup>th</sup> Ed. Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman. 2007.

### Unit-IV:

1. Organic spectroscopy, William Kemp

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2. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.
3. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. Instrumental Methods of Analysis, 7<sup>th</sup> Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.
4. C.N. Ban well: Fundamentals of Molecular Spectroscopy.

**LABORATORY COURSE**  
**CHEMISTRY LAB PAPER-VI**  
**(Qualitative analysis of Organic Compounds)**  
**(03 Hrs per week, 01 Credit) 45 Hrs**

**I. Qualitative analysis of Organic Compounds:**

1. Identification of an organic compound through the functional group analysis. Determination of melting point and preparation of suitable derivatives of the following: Carboxylic acids, Phenols, amines, urea, thiourea, carbohydrates, aldehydes, ketones, amides, nitro hydrocarbons, ester and naphthalene.
2. Spectral & Chromatography analysis:
  1. Spectral analysis of organic compounds with different functional groups using UV, IR, <sup>1</sup>HNMR and Mass spectroscopy. (Eg:-Ethanol, Acetophenone and Aniline)
  2. Thin layer chromatography (TLC): Determination of R<sub>f</sub> values and identification of organic compounds: preparation and separation of 2,4-dinitrophenyl hydrazones of acetone and 2-butanone using toluene and light petroleum(40:60)

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**B.Sc. Chemistry III Year  
Semester-VI, Paper-VI  
Discipline Specific Elective-A (4 Credits)  
Medicinal Chemistry**

60Hrs

**Unit- I: Introduction and Terminology**

**S6-E-A-I: Diseases:** Common diseases, infective diseases— insect borne, air-borne, water-borne and hereditary diseases.

**Terminology in Medicinal Chemistry:** Drug, Active Pharmaceutical Ingredient (API), Pharmaceuticals, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, anti metabolites and therapeutic index.

**Drugs: Nomenclature:** Chemical name, Generic name and Trade names with examples;  
**Classification:** Classification based on structures and therapeutic activity with examples.

**ADMET:** a) Absorption: Definition, absorption of drugs across the membrane – active and passive absorption, routes of administration of drugs. b) Distribution: definition and effect of plasma protein binding. c) Metabolism: definition, phase I and phase II reactions. d) Elimination: definition and renal elimination. Toxicity.

15Hrs

**Unit-II: Enzymes and Receptors**

**S6-E-A-II: Enzymes: Introduction.** Mechanism and factors affecting enzyme action, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance. Types of inhibition - reversible, irreversible and their subtypes with examples.

**Receptors:** Introduction, Drug action-receptor theory, Mechanism of drug action, concept of agonists and antagonists with examples. Drug receptor interactions involved in drug receptor complex. binding role of -OH group, -NH<sub>2</sub> group, quaternary ammonium salts and double bond. Structure – activity relationships of drug molecules, explanation with sulfonamides.

**Unit- III: Synthesis and Therapeutic Activity of Drugs**

**S6-E-A-III: Introduction,** synthesis and therapeutic activity of

**Chemotherapeutics:** Sulphanilamide, dapsone, Pencillin-G (semi synthesis), Chloroquin, Isoniazid, Cisplatin and AZT.

**Drugs to treat metabolic disorders:** Anti diabetic - Tolbutamide; Antiinflammatory – Ibuprofen; Cardiovascular- Glyceryl trinitrate; Antipyretic (paracetamol, aspirin) and Antacid- Omeprazole.

**Drugs acting on nervous system:** Anesthetics-definition, Classification-local and general. Volatile- Nitrous oxide, chloroform uses and disadvantages. Local anaesthetics – benzocaine.

**Unit- IV: Molecular Messengers, Vitamins and Micronutrients**

**S6-E-A-IV: Molecular Messengers:** Introduction to hormones and neurotransmitters, Thyroid hormones, Antithyroid drug- Carbimazol. Adrenaline: Adrenergic drugs- salbutamol, atenelol. Serotonin: SSRIs- fluoxetine. Dopamine: Antiparkinson drug- Levodopa .

15Hrs

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**Vitamins and Micronutrients: Introduction, vitamin sources, Deficiency disorders and remedy of Vitamins A,B, C, D, E K and micronutrients – Na, K, Ca, Cu, Zn and I .**

**Recommended Text Books and Reference books**

1. Introduction to Medicinal Chemistry, G.L. Patrick, Oxford University Press, New York. 2013.
2. Medicinal Chemistry, Thomas Nogrady, Oxford Univ. Press, New York.2005.
3. Foye's Principles of Medicinal Chemistry, David William and Thomas Lemke, Lippincott Williams & Wilkins, 2008.
4. Medicinal Chemistry, Ashutosh Kar , New Age International, 2005.
5. Synthetic Drugs, O.D.Tyagi & M.Yadav, Anmol Publications,1998.
6. Medicinal Chemistry, Alka L. Gupta, Pragati Prakashan.
7. Drugs, G. L. David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K. L. N. Reddy, C. Sudhakar, Universities Press (India) Ltd. 2012.

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**B.Sc. Chemistry III Year**  
**Semester –VI, Paper-VI**  
**Discipline Specific Elective-B (4 Credits)**  
**Agricultural and Fuel Chemistry**

60 Hrs

**Unit I: – Pesticides**

15Hrs

**S6-E-B-I: Introduction, Definition, classification of pesticides based on use (target). Toxicity and chemical structure with examples. Adverse effects of pesticides and its impact on environmental pollution.**

Synthesis, manufacture and uses of representative pesticides: Organochlorines (Cypermethrin); Organophosphates (Parathion); Carbamates (Carbaryl); Quinones (Chloranil), Anilides (Alachlor).  
**Pesticide formulations: Dusts, Granules, Wettable powders, Emulsions and Aerosols.**

**Biopesticides :** Introduction: Potential pesticidal plants of India, Role of Neem in plant protection-constituents, Azadirachtin and its role in pest control, Structure and mode of action of Pyrethrins (pyrethrin-1) and Pyrethroids (permethrin) and nicotinoids (Imidacloprid).

**Unit II: – Fertilizers**

15Hrs

**S6-E-B-II: Introduction: (need of fertilizers), functions of essential plant nutrients (N, P, K), Classification formula and uses of fertilizers:**

**Nitrogenous fertilizers:** Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride and their uses.

**Phosphate fertilizers:** Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate and their uses.

**Potassium fertilizers:** Potassium chloride, potassium nitrate, potassium sulphate and uses.  
**Complex fertilizers:** Diammonium Phosphate and mixed fertilizers their uses. Manufacture of urea and Super phosphate of lime and their reactions in the soil.

**Biofertilizers –** Introduction, definition, classification, Rhizobium, Azatobactor, Azospirillum, Azolla, Blue Green Algae, Vermicomposting and uses.

**Organic farming:** The principal methods, crop rotation, green manures and compost, biological pest control, and mechanical cultivation and uses.

**Unit III: Energy Sources and Coal**

15Hrs.

**S6-E-B-III: Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.**

**Coal:** Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar based chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

**Unit IV: Petroleum and its products, petrochemicals and non petroleum fuels**

15Hrs.

**S6-E-B-IV:**

**Petroleum and its products**

**Petroleum:** Origin, Composition of crude petroleum and classification. Properties- flash point and its determination, Knocking and antiknocking compounds; Octane number. and Cetane number. Distillation of crude petroleum, Fractional Distillation - Principle and process, refining, Fractions and uses. Cracking -Thermal and catalytic cracking, Reforming

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**B.Sc., III YEAR CHEMISTRY**

**SEMESTER-V**

**DSE-A: Chemistry Paper-V**

***(Spectroscopy & Chromatography)***

**(04 credits)**

**60 Hrs (04 Hrs/week)**

**UNIT-I: Molecular Spectroscopy (15 Hrs)**

**S5-A-E-I:** Introduction to electromagnetic radiation, interaction of electromagnetic radiations with molecules, various types of molecular spectra.

**Rotational spectroscopy (Microwave spectroscopy)**

Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules eg. HCl.

**Infra red spectroscopy**

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant (Problems). Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print nature of infrared spectrum

**Electronic spectroscopy**

Bonding and anti-bonding molecular orbitals, electronic energy levels of molecules ( $\sigma$ ,  $\pi$ ,  $n$ ), types of electronic transitions:  $\sigma$ - $\sigma^*$ ,  $n$ - $\sigma^*$ ,  $n$ - $\pi^*$ ,  $\pi$ - $\pi^*$  with suitable examples. Selection rules, Terminology of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption characteristics of chromophones: diene, enone and aromatic chromophores. Representation of UV-Visible spectra. General features of absorption-spectroscopy transmittance, absorbance, and molar absorptivity. Beer-Lambert's law and its limitations.

**UNIT-II: NMR & Mass Spectroscopy (15 Hrs)**

**S5-A-E-II: Proton Magnetic Resonance Spectroscopy**

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, factors affecting chemical shifts, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations.  $^1\text{H}$  NMR spectrum of – ethyl bromide, acetaldehyde, 1, 1, 2- tribromo ethane, ethyl acetate and acetophenone.

**Mass Spectrometry**

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular formula. Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

**UNIT-III: Separation techniques-I (15 Hrs)**

**S5-A-E-III: Solvent Extraction-** Principle, Methods of extraction: Batch extraction, continuous extraction and counter current extraction. Application– Determination of Iron (III).

**Chromatography:** Classification of chromatographic methods, principles of differential migration, adsorption phenomenon, nature of adsorbents, solvent systems.



**Thin layer Chromatography (TLC):** Advantages, preparation of plates, solid phase and mobile phase used in TLC, eluotropic series, development of the chromatogram, Detection of the spots, factors effecting  $R_f$  values and applications of TLC.

**Paper Chromatography:** Principle, choice of paper and solvent systems, development of chromatogram – ascending, descending, radial and two dimensional chromatography, detection of spots, and applications of paper chromatography.

#### **UNIT-IV: Separation techniques-II (15 Hrs)**

**S5-A-E-IV: Column Chromatography-** Principle, Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

**Ion exchange chromatography:** Principle, cation and anion exchange resins, its application in separation of ions, de-ionized water.

**Gas Chromatography:** Principle, theory and instrumentation (Block Diagram), Types of stationary phases and carrier gases (mobile phase), application of GC.

**High performance liquid chromatography:** Principle, theory and instrumentation, stationary phases and mobile phases. Applications of HPLC, analysis of Paracetamol.

#### **Recommended Text Books and Reference Books:**

1. Fundamentals of Molecular Spectroscopy, C.N. Ban well & Mc Cash.
2. Organic spectroscopy, William Kemp, Palgrave Macmillan; 2<sup>nd</sup> Revised edition.
3. Spectroscopy, B K Sharma Krishna Prakashan Media, 1981.
4. Elements of Organic spectroscopy, YR Sharma.
5. Applications of Absorption spectroscopy of Organic compounds ( English paper back, Dyer R.John)
6. Organic chemistry, Morrison and Boyd, Pearson Publications.
7. Introduction to Spectroscopy by Donald Pavia, Gary Lampman and George Kriz. Saunders College Division, 2001.
8. Chemistry text book for B.Sc., published by Telugu academy, Govt. of Telangana.
9. Analytical Chemistry by David Krupadanam, Universities Press (India) Limited.
10. Principles of Instrumental Analysis, D.A.Skoog, F.J.Holler & T.A. Nieman, Cengage Learning India Ed.
11. Fundamentals of Analytical Chemistry 6<sup>th</sup> Edn, D.A.Skoog, D.M. West, F.J.Holler, Saunders College Publishing, Fort worth (1992).
12. Instrumental Methods of Analysis, 7th Ed. Willard, H.H., Merritt, L.L., Dean, J. & Settle, F.A. Wordsworth Publishing Co.Ltd., Belmont, California, USA, 1988.
13. A Text Book of Quantitative Inorganic Analysis 7<sup>th</sup> Ed., Vogel, A.I. Prentice Hall.
14. Analytical Chemistry 7 th Edition by Gary D.Christian (2004)
15. Separation Methods, M.N Sastry, Himalaya Publication (2004)

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**B.Sc., III YEAR CHEMISTRY**

**SEMESTER-V**

**DSE-B: Chemistry Paper-V**

***(Metallurgy, Dyes and Catalysis)***

**(04 credits)**

**60 Hrs (04 Hrs/week)**

**Unit I: General Principles of Metallurgy and Production of Non Ferrous Metals (15 Hrs)**

**S5-E-B-I: Pyrometallurgy:** Drying and calcination, roasting, smelting, products of smelting,

**Hydrometallurgy:** Leaching methods, leaching agents, leaching of metals, oxides and sulphides.

Separation of liquid and solid phases and processing of aqueous solutions

**Electrometallurgy:** Electrolysis, Refining electrolysis, electrolysis from aqueous solutions, fused-salt electrolysis

**Refining processes:** Chemical and physical refining processes

**Production of selected non-ferrous metals (Copper, Nickel, Zinc):** Properties, raw materials, production (flow charts presentations and chemical reactions involved) and uses.

**Unit II: Natural and Synthetic Dyes (15 Hrs)**

**S5-E-B-II:** Definition and Classification of dyes - Natural dyes, Synthetic dyes: based on chemical constitution of dyes; Chemical nature of dyes; Application of dyes.

**Structures of Natural dyes:** Indigo, Tyrian purple, Alizarine, Indigotin.

**Structures of Synthetic dyes:** Nitro dyes, Nitroso dyes, Azo dyes (Mono azo dye, Bis azo dyes) Diaryl methane dyes, Triaryl methane dyes, Xanthenes dyes, Phenolphthalein, Fluoroseine, Acridine dyes.

**Synthesis of dyes:** Mono azo dye, Bis azo dyes (Congo red), Auromine O, Malachite Green, Crystal Violet, Rhodamine B, Acridine Yellow, Indigotin. Binding of dyes to fabric. Applications of dyes.

**Unit III: Catalysis-I (15 Hrs)**

**S5-E-B-III: Homogeneous and heterogeneous catalysis** - Definition of a catalyst and catalysis. Comparison of homogeneous and heterogeneous catalysis with specific examples. General characteristics of catalytic reactions.

**Acid-base catalysis-** Examples of acid and base catalysed reactions, hydrolysis of esters. Kinetics of acid catalysed reactions. Specific acid and general acid catalysis, Kinetics of base catalysed reactions. Specific base and general base catalysis. Examples- Aldol condensation and decomposition of nitramide, base catalysed conversion of acetone to di acetone alcohol, Mutarotation of Glucose. Effect of pH on reaction rate of acid and base catalysed reactions.

**Phase transfer catalysis:** Principle of phase transfer catalysis, classification of phase transfer catalysts. Factors influencing the rate of PTC reactions.

**Unit IV: Catalysis-II (15 Hrs)**

**S5-E-B-IV: Enzyme catalysis-** Characteristics of enzyme catalysis, Examples: (i) Invertase in inversion of cane sugar (ii) Maltase in conversion of maltose to glucose (iii) Urease in decomposition of urea (iv) Zymase in conversion of glucose to ethanol (v) working of carbonic anhydrase and (vi) Mechanism of oxidation ethanol by alcohol dehydrogenase. Factors affecting enzyme catalysis. Effect of temperature, pH, concentration and effect of inhibitor on enzyme catalysed reactions, Catalytic efficiency.

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Kinetics of enzyme catalysed reactions: Michaelis-Menton Equation. Mechanism of enzyme catalysed reactions. Significance of Michaelis constant ( $K_m$ ) and maximum velocity ( $V_{max}$ ), Lineweaver-Burk plot. Types of enzyme inhibitors.

**Recommended Text Books and Reference Books:**

1. Industrial Chemistry B.K.Sharma
2. Engineering Chemistry, Jain and Jain
3. Industrial Chemistry, E. Stocchi, Vol-I, Ellis Horwood Ltd. UK.
4. Handbook of Industrial Chemistry, J. A. Kent: Riegel's, CBS Publishers, New Delhi.
5. Theory of production of non-ferrous metals and alloys Study. Kateřina Skotnicová, Monika Losertová, Miroslav Kursa.
6. The Chemistry of Synthetic Dyes, Volume 4, K.Venkataraman, Elsevier.
7. Organic Chemistry Vol-I by I.L. Finar.
8. Organic Chemistry by Jennice, Gorzinski Smith.
9. Natural Dyes: Sources, Chemistry, Application and Sustainability Issues by Sujata Saxena and A. S. M. Raja.
10. Physical Chemistry by Atkins and De Paula, 8 th Edn.
11. Physical Chemistry by Puri, Sharma and Pattania, 2017.
12. Kinetics and mechanism of chemical transformations by Rajarajm and Kuriacose, Published by Macmillan India Ltd.
13. Text book of Physical Chemistry by K.L. Kapoor Macmillan, 1999.
14. Catalysis by J.C. Kuriacose, Macmillan Publishers India Limited, 1980.
15. Phase Transfer Catalysis, Fundamentals, Applications and Industrial perspectives, C.M.Stark, C.Liotta & M.Halpern, Academic Press.
16. Phase Transfer Catalysis, E.V.Dehmlow & S.S. Dehmlow, Verlag Chemie, Weinheim.

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**B.Sc., III YEAR CHEMISTRY**

**SEMESTER-V**

**LABORATORY COURSE**

**Paper –V: Experiments in Physical Chemistry-I**

**(01 Credit)**

**45 Hrs (03 Hrs/week)**

**1. Distribution law**

- a) Determination of molecular status and partition coefficient of benzoic acid in Toluene and water.
- b) Determination of distribution coefficient of acetic acid between n-butanol and water.

**2. Electrochemistry**

- a) Determination of cell constant of conductivity cell.
- b) Verification of Ostwald's dilution law- Determination of dissociation constant ( $K_a$ ) of acetic acid by conductivity measurements.

**3. Colorimetry**

- a) Verification of Beer's - Lamberts law for  $KMnO_4$
- b) Determination of the concentration of the given  $KMnO_4$  solution.

**4. Adsorption**

- a) Adsorption of acetic acid on animal charcoal- Verification of Freundlich adsorption isotherm.

**5. Physical constants**

- a) Surface tension and b) Viscosity of liquids. (Demonstration Experiment)

**Reference books:**

1. Senior Practical Physical Chemistry, B. D Khosla, V. C. Garg, Adarsh Gulati Published by R. Chand & Co.
2. Practical Physical Chemistry, B. Vishwanathan and P.S. Raghavan. Viva Books.
3. Practicals in Physical Chemistry by P.S. Sindhu ISBN-10: 1-4039-2916-5/1403929165 ISBN-13: 978-1-4039-2916-7/9781403929167.







## B.Sc., III YEAR CHEMISTRY

### SEMESTER-VI

#### DSE-A: Chemistry Paper-VI

*(Medicinal Chemistry)*

(04 credits)

60 Hrs (04 Hrs/week)

#### Unit- I: Introduction and Terminology (15 Hrs)

**S6-E-A-I: Diseases:** Common diseases, infective diseases—insect borne, air-borne, water-borne and hereditary diseases.

**Terminology in Medicinal Chemistry:** Drug, Active Pharmaceutical Ingredient (ADI), Pharmaceuticals, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, anti metabolites and therapeutic index.

**Drugs:** Nomenclature: Chemical name, Generic name and Trade names with examples; Classification: Classification based on structures and therapeutic activity with examples.

**ADMET:** a) Absorption: Definition, absorption of drugs across the membrane – active and passive absorption, routes of administration of drugs. b) Distribution: definition and effect of plasma protein binding. c) Metabolism: definition, phase I and phase II reactions. d) Elimination: definition and renal elimination. Toxicity.

#### Unit-II: Enzymes and Receptors (15 Hrs)

**S6-E-A-II: Enzymes: Introduction,** Mechanism and factors affecting enzyme action, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance. Types of inhibition - reversible, irreversible and their subtypes with examples.

**Receptors:** Introduction, Drug action-receptor theory, Mechanism of drug action, concept of agonists and antagonists with examples. Drug receptor interactions involved in drug receptor complex. Binding role of -OH group, -NH<sub>2</sub> group, quaternary ammonium salts and double bond. Structure – activity relationships of drug molecules, explanation with sulfonamides.

#### Unit- III: Synthesis and Therapeutic Activity of Drugs (15 Hrs)

**S6-E-A-III:** Introduction, synthesis and therapeutic activity of:

**Chemotherapeutics:** Sulphanilamide, dapsone, Penicillin-G (semi synthesis), Chloroquin, Isoniazid, Cisplatin and AZT.

**Drugs to treat metabolic disorders:** Anti diabetic - Tolbutamide; Anti-inflammatory – Ibuprofen; Cardiovascular- Glyceryl trinitrate; Antipyretic (paracetamol, aspirin) and Antacid- Omeprazole.

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**Drugs acting on nervous system:** Anesthetics-definition, Classification-local and general. Volatile-Nitrous oxide, chloroform uses and disadvantages. Local anesthetics – benzocaine.

**Unit- IV: Molecular Messengers and Vitamins and Micronutrients (15 Hrs)**

**S6-E-A-IV: Molecular Messengers:** Introduction to hormones and neurotransmitters, Thyroid hormones, Antithyroid drug-Carbimazol. Adrenaline: Adrenergic drugs- salbutamol, atenelol. Serotonin: SSRIs- fluoxetine. Dopamine: Antiparkinson drug- Levodopa .

**Vitamins and Micronutrients:** Introduction, Vitamin sources, Deficiency disorders and remedy of Vitamins A,B, C, D, E, K and micronutrients – Na, K, Ca, Cu, Zn and I .

**Recommended Text Books and Reference Books:**

1. Introduction to Medicinal Chemistry, G.L. Patrick, Oxford University Press, New York. 2013.
2. Medicinal Chemistry, Thomas Nogrady, Oxford Univ. Press, New York.2005.
3. Foye's Principles of Medicinal Chemistry, David William and Thomas Lemke, Lippincott Williams & Wilkins, 2008.
4. Medicinal Chemistry, Ashutosh Kar, New Age International, 2005.
5. Synthetic Drugs, O.D.Tyagi & M.Yadav, Anmol Publications,1998.
6. Medicinal Chemistry, Alka L. Gupta, Pragati Prakashan.
7. Drugs, G. L. David Krupadanam, D.Vijaya Prasad, K.Varaprasad Rao, K. L. N. Reddy, C. Sudhakar, Universities Press (India) Ltd. 2012.

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## B.Sc., III YEAR CHEMISTRY

### SEMESTER-VI

#### DSE-B: Chemistry Paper-VI

*(Agricultural & Fuel Chemistry)*

(04 credits)

60 Hrs (04 Hrs/week)

#### Unit I: Pesticides (15 Hrs)

**S6-E-B-I: Introduction**, Definition, classification of pesticides based on use (target). Toxicity and chemical structure with examples. Adverse effects of pesticides and its impact on environmental pollution.

Synthesis, manufacture and uses of representative pesticides: Organochlorines (Cypermethrin); Organophosphates (Parathion); Carbamates (carbaryl); Quinones (Chloranil), Anilides (Alachlor).

**Pesticide formulations:** Dusts, Granules, Wettable powders, Emulsions and Aerosols.

**Biopesticides :** Introduction: Potential pesticidal plants of India, Role of Neem in plant protection-constituents, Azadirachtin and its role in pest control, Structure and mode of action of Pyrethrins (pyrethrin-1) and Pyrethroids (permethrin) and nicotinoids (Imidacloprid).

#### Unit II: Fertilizers (15Hrs)

**S6-E-B-II: Introduction:** (need of fertilizers), functions of essential plant nutrients (N, P, K), Classification formula and uses of fertilizers:

**Nitrogenous fertilizers:** Ammonium nitrate, Urea, Calcium Cyanamide, Calcium Ammonium Nitrate, Sodium Nitrate, Ammonium Chloride and their uses.

**Phosphate fertilizers:** Normal super phosphate, Triple Super Phosphate, Ammonium Phosphate and their uses.

**Potassium fertilizers:** Potassium chloride, potassium nitrate, potassium sulphate and uses.

**Complex fertilizers:** Diaammonium Phosphate and mixed fertilizers their uses. Manufacture of urea and Super phosphate of lime and their reactions in the soil.

**Biofertilizers:** Introduction, definition, classification, Rhizobium, Azatobactor, Azospirillum, Azolla, Blue Green Algae, Vermicomposting and uses.

**Organic farming:** The principal methods, crop rotation, green manures and compost, biological pest control, and mechanical cultivation and uses.

#### Unit III: Energy Sources and Coal (15Hrs)

**S6-E-B-III:** Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.

**Coal:** Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar based chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

#### **Unit IV: Petroleum and its products, Petrochemicals and non petroleum fuels (15Hrs)**

##### **S6-E-B-IV: Petroleum and its products**

**Petroleum:** Origin, Composition of crude petroleum and classification. Properties-flash point and its determination, Knocking and anti-knocking compounds; Octane number and Cetane number. Distillation of crude petroleum, Fractional Distillation - Principle and process, refining, fractions and uses. Cracking -Thermal and catalytic cracking, Reforming.

**Petroleum products** – Petrol, Diesel, LPG, Kerosene, Tar and their applications.

**Petrochemicals**-Vinyl acetate, Propylene oxide, Isoprene and their uses.

**Lubricants:** Classification of lubricants- Solid, semi solid and liquids; Properties (viscosity, flash point, fire point, cloud point, pour point) and their determination. Functions of Lubricants, Mechanism of lubrication.

**Non-Petroleum fuels:** Natural Gas- CNG, LNG, clean Fuels- H<sub>2</sub> gas, ethanol, Fuel from waste- bio gas, Fuel from bio mass-Bio ethanol, biodiesel, and Synthetic fuels- syngas based.

##### **Recommended Text Books and Reference Books:**

1. Chemistry of pesticides, N. N. Melnikov, Springer-Verlag- Technology & Engineering (2012).
2. Pesticide Synthesis, Thomas A. Unger, Elsevier, (2000).
3. Pesticides, R. Cremlyn, John Wiley, 1980.
4. Manures and Fertilisers, K. Kolay, Published by Atlantic (2007).
5. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).
6. A Text Book of Engineering Chemistry Paperback-2017 by Shashi Chawla.
7. Industrial Chemistry, Vol-I, Stocchi.E, Ellis Horwood Ltd. UK (1990).
8. Jain, P.C. & Jain, M. Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
9. Engineering Chemistry by Shashi Chawla, Dhanpat Rai & Sons, Delhi.

*J.P.K.*

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**B.Sc., III YEAR CHEMISTRY**

**SEMESTER-VI**

**LABORATORY COURSE**

**Paper –V: Experiments in Physical Chemistry-II**

**(01 Credit)**

**45 Hrs (03 Hrs/week)**

**1. Kinetics**

- a) Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.
- b) Determination rate of decomposition of hydrogen peroxide catalyzed by  $\text{FeCl}_3$ .

**2. Electrochemistry**

**A. Potentiometry:**

- a) Determination of redox potential of  $\text{Fe}^{2+}/\text{Fe}^{3+}$  by potentiometric titration of ferrous ammonium sulphate vs potassium dichromate.
- b) Precipitation titration of  $\text{KCl}$  vs  $\text{AgNO}_3$  –Determination of given concentration of silver nitrate.

**B. pH metry:**

- a) pH metric titration of strong acid ( $\text{HCl}$ ) vs strong base- Determination of the concentration of given acid.
- b) pH metric titration of strong acid (acetic acid) with strong base ( $\text{NaOH}$ )- Determination of acid dissociation constant ( $K_a$ ) of weak acid.

**3. Conductometry:**

- a) Determination of overall order: Saponification of ethyl acetate with  $\text{NaOH}$  by conductance measurement

**Reference books:**

1. Senior practical physical chemistry, B.D.Khosla, V.C.Garg, Adarsh Guati.
2. Advanced Practical Physical chemistry, J.B.Yadav.
3. Practical Physical chemistry, B.Vishvanathan and P.S.Raghavan.
4. Practical Physical chemistry, P.S. Sindhu.

*Joshi*

*Sharma*

*NU Smeedy*