NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science & Technology

SYLLABUS FOR CORE SUBJECT (D.S.C.): BOTANY

As Per The U. G. C. Guidelines

Based on
Choice Based Credit System (CBCS)

F. Y. B. Sc. BOTANY SEMESTER-WISE SYLLABUS
(Theory and Practical)

Semester-I:

Bot. 101: Microbial Diversity, Algae & Fungi
Bot. 102: Plant Taxonomy
Bot. 103: Practical Based on Bot. 101 & 102

Semester-II:

Bot. 201: Diversity of Archegoniates
Bot. 202: Plant Ecology
Bot. 203: Practical Based on Bot. 201& 202

W. E. F. June, 2018

Year-I: Core Subject (DSC)
Structure of F. Y. B.Sc. under CBCS
w.e.f. June 2018

Year	Semester	Paper	Code	Title	Marks	Credits
I	I	I	Bot.101	Microbial Diversity, Algae & Fungi	60: 40	2
		II	Bot.102	Plant Taxonomy	60: 40	2
		III	Bot.103	Practical (LAB – I)	60: 40	2
	II	I	Bot.201	Diversity of Archegoniates	60: 40	2
		II	Bot.202	Plant Ecology	60: 40	2
		III	Bot.203	Practical (LAB – II)	60: 40	2

NORTH MAHARASHTRA UNIVERSITY, JALGAON
Syllabus of F.Y.B.Sc. Botany w.e.f. June, 2018
Semester –I
Paper-I
Bot. 101: Microbial Diversity, Algae & Fungi Total: 30 L

Aims and Objectives:

1. To study the diversity among Microbes.
2. To study systematic, morphology and structure of Bacteria, Viruses, Algae and Fungi.
3. To study the life cycle pattern of Bacteria, Viruses, Algae and Fungi.
4. To study the useful and harmful activities of Bacteria, Viruses, Algae and Fungi.

Unit 1: Microbes **2L**

1.1:Introducdtion and main groups of microbes : Prions, Viroids, Viruses, Rickettsias, mycoplasmas , Bacteria,cyanobacteria .

1.2: Classification of microorganisms – R.H.Whittaker's (1969) five kingdom concept.

Unit 2: Viruses **7L**

2.1 Introduction, Discovery and Characteristics of Viruses.

2.2 General morphology of viruses: Helical, Polyhedral, Enveloped and Complex viruses.

2.3 Nature of viruses (living and nonliving)

2.4 Ultra structure of viruses

2.5 DNAVirus (T-Phase)and RNA Virus(TMV)

2.6 Reproduction of Bacteriophase : Lytic and Lysogenic cycle.

2.7 Economic importance

2.8Plant diseases caused by viruses w.r.t. symptoms, causal organism and control measures of

i. Yellow vein mosaic disease of Lady's finger

ii. Leaf curl of Tomato

Unit 3: Bacteria **7L**

3.1 Introduction, discovery and General Characters.

3.2 Classification of Bacteria on the basis of morphology.

3.3Structureof Bacterial Cell

3.4 Gram positive and Gram negative Bacteria

3.5 Reproduction - Asexual and Sexual (Conjugation)

3.6 Economic Importance of Bacteria - useful and harmful activities

3.7Study of Bacterial diseases w.r.t. causal organism, symptoms and control measures of

i) Citrus canker

ii) Black arm of Cotton

Unit 4: Algae **7L**

4.1 Introduction, definition and General Characters of algae

4.2 Habitats of algae: Aquatic, Terrestrial and algae unusual habitats

4.3Thallus structure in algae.

4.4 Reproduction: Vegetative, Asexual and Sexual

4.5Classification of algae according to G. M. Smith (1955) up to classes with reasonsgiving at least two examples from each class.

4.6 Economic importance of algae

i. Agricultureii. Industries iii. Medicineiv. Energy Production

4.7 Study of life cycle w.r.t. Systematic position, thallus structure and Reproductionof ***Nostoc,***and***Spirogyra.***

Unit 5: Fungi **7L**

5.1 Introduction, definitionand General Characters

5.2 Thallus structure and mode of nutrition

5.3Classification of Fungi , according to G.M. Smith upto classes with reasonsselecting at least two example of each class.

5.3 Economic importance of Fungi (Agriculture, Industries, Food & Medicine)

5.4 Study of life cycle w. r. t. Systematic position thallus structurereproduction*of Rhizopus,* and *Agaricus.*

5.5 Lichens: Definition, Characters, Types - Crustose, Foliose,Fruticose and economics importance.

5.6 Definition , General account, significance of Mycorrhiza , Types : Ecto and Endomycorrhiza.

Note: Student activates like seminars, quiz, debate, assignments, field work, study Project & models etc. are part of curriculum for all units in all papers.

Reference Books:

1. Agrwal, S. B. and Srivastav (1985)Modern Text Book of Botany Vol. I Algae, Fungi, Bacteria Viruses and Lichen, Universial Publication, Agra.
2. Biswas, S. B. and AmitaBiswas (1986 Ed.)An Introduction to Viruses, Vikas Publishing House (P) Ltd. New Delhi.
3. Vashita, B.R. (2010) S. A Text Book of Algae Chand and Company (P.)Ltd New Delhi.
4. Vashita ,B.R. (2010) S. A Text Book of Fungi Chand and Company (P.)Ltd New Delhi.
5. Sarabhai, B. P. &Arora C.K. (1995) . A Text Book of Algae Anmol Publication, New Delhi.
6. Salle, A.J. (1974) Fundamental Principles of Bacteriology (TMH Ed.) New Delhi.
7. Gangulee, H.C. and Kar, A.K.(1998) College Botany Vol. II New Central Book Agency, Kolkota.
8. Pandey B. P. (2014) College Botany Volume 1S. Chand publications, New Delhi.
9. Pandey, S. N. and Trivedi (1997) A Text Book of Botany Vol. I Vikas Publishing House, New Delhi.
10. Sharma, P D. (1998) A Text Book of Fungi Rastogi Publication, Meerut.
11.Sharma, P D. (2009) A Text Book of Algae Tata McGraw Hill Publication, New Delhi.

Paper II

Bot. 102: Plant Taxonomy

Total: 30L

Aims and Objectives:

1. To study the diversity of angiosperms.
2. To study the comparative account among the families of angiosperms.
3. To study the economic importance of the angiospermic plants.
4. To study the distinguishing features of angiosperm families.

Unit 1: Introduction (3 L)

1.1 Definition, Scope and Importance

1.2 Functions of Taxonomy

1.2.1 Identification

1.2.2 Nomenclature

1.2.3 Classification

Unit 2: Taxonomic hierarchy (5 L)

2.1 Principles (I to IV) & Rules (ICN)

2.2 Ranks of Classification: Major Categories

2.3 Binomial Nomenclature

2.4 Author Citation & Rejection of names.

Unit 3: Systems of Classification (5 L)

3.1 Types of Classification.

3.1.1 Artificial

3.1.2 Natural

3.1.3 Phylogenetic

3.2 Outline of Bentham & Hooker's system of classification up to series.

3.3 Merits and Demerits

Unit 4: **Study of Plant Families w.r.t. systematic position, general characters, distinguishing characters and economic importance.** (6 L)

4.1 Malvaceae

4.2 Solanaceae

4.3 Euphorbiaceae

4.4 Cannaceae

Unit 5: Herbarium (3 L)

5.1 Definition, Techniques and Functions.

5.2 Importance of Herbaria.

Unit 6: Botanical Gardens (3 L)

6.1 Definition and Functions.

6.2 Special Features of Following:

6.2.1 Indian Botanical Garden, Kolkata.

6.2.2 Royal Botanical Garden, Kew, England.

Unit 7: Numerical Taxonomy (2 L)

7.1 Definition & Application

Unit 8: Modern Trends in Taxonomy (3 L)

8.1 Taxonomic evidences from:

8.1.1 Palynology

8.1.2 Cytology

8.1.3 Phytochemistry

Reference Books:

1. Ganguly, H.C. & K. S. Das (1986) College Botany Vol.-.I (6th Edition), New CentralBookAgency, Calcutta, India.
2. Ganguly, H.C., K.S.Das and C.T.Datta (1968) College Botany Vol.I , New Central BookAgency, Calcutta, India.
3. Kumar, N.C.(1992) An Introduction to Taxonomy of Angiosperm. Himalaya PublishingHouse, Bombay, India.
4. Lawrence G.H.M. (1951) Taxonomy of Vascular plants. Macmillan, New York,USA.
5. Naik, V.N. (1984) Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
6. Pandey, B.P.(1997) Taxonomy of Angiosperms. S. Chand & Company Ltd., New Delhi,India.
7. Sharma, O.P. (1997) Plant Taxonomy. Tata McGraw-Hill Publishing Co. Ltd. New Delhi,India.
8. Shivarajan, V.V. (1984) Introduction to Principles of Plant Taxonomy. Oxford &IBHPublishing Co. New Delhi, India.
9. Singh, V. and Jain,D.K. (1992) Taxonomy of Angiosperms.Rastogi Publication, Meerut,India.
10. Subramanyam, N.S. (1997) Modern Plant Taxonomy.Vikas Publishing house, New Delhi,India.
11. MukerjeeSusilkumar(1984) College Botany Vol III Published by J.N. Sen. B.S.I.NewCentral Book Agency Calcutta.
12. Vashistha, P.C. (1992) Taxonomy of Angiosperms. R. Chand & Co. Publishers, New Delhi,India.

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Paper III
Bot. 103: Practical
(Based on Bot.101 and Bot.102)

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1. Study of equipments used in Microbiology: Spirit lamp, Inoculation Loop, Hot air oven, Laminar Air Flow (LAF) and Incubator.
2. A) Study of viruses and Bacteria using Electron Photomicrographs (TMV, Bacteriophage, Cocci, Bacillus, Spirillum Bacteria)
   B) Gram staining technique.

3&4 A) Study of Plant diseases w.r.t.causal organism and symptoms of the Following:

- a. Viral
  - i. Yellow vein mosaic disease of Lady's finger
  - ii. Leaf curl of Papaya
- b. Bacteria
  - i. Citrus canker
  - ii. Black arm of cotton
- c. Fungi
  - i. Green mould of citrus fruits
  - ii. Wheat rust (Specimen / Slide)

B) Study of growth forms of lichens (Crustose, Foliose and Fruticose)

C) Study of Mycorrhiza: (Ectomycorrhiza and Endomycorrhiza) by Photographs.

5, 6:Study of systematic position, vegetative and reproductive structures of the following :

A. *Nostoc*

I)Specimem of *Nostoc* Ball

II) Mounting of thallus: Colony, Trichome& filament

III) Cell structure

B. *Spirogyra*

I) Mounting of thallus (Vegetative)

II) Filament & Cell Structure

III) Congugation (P.S)

C.*Rhizopus*

I)Asexualthallus: Mycelium, Sporangia & Spores

II) Zygospore (P.S)

D.*Agaricus*

I) Specimen of full grown Mushroom

II) V. S. of gill : Mycelium, Basidia&basidiospores

7. How to Describe Angiospermic Plants.

8, 9, 10.Study of Plant families w. r. t. Systematic position, Morphological characters, Floral formula and floral diagram.

i. Malvaceae ii. Solanaceae

iii. Euphorbiaceaeiv. Cannaceae

11. Preparation of artificial key based on vegetative & reproductive characters.
12. Herbarium and its techniques.

Submission: 1. Any five wild plants herbarium/photographs..
2. Any Three Algae & Two Diseased Plant parts
3. Tour report

Note: *Short or long excursion tour and visit to any botanical garden is compulsory.*

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Semester – II
Paper I
Bot. 201: Diversity of Archegoniates

Total: 30 L

Aims and Objectives:

1. To study salient features of Archegoniates.
2. To make students aware of the status of higher cryptogams& gymnosperms as a group in plant kingdom.
3. To study the life cycles of selected genera.
4. To study economic and ecological importance of Archegoniates.

Unit 1: Introduction to Archegoniate (3L)

1.1 Diagnostic features of archegoniate and Transition to land habit
1.2 Alternation of generations.

Unit 2: Bryophytes (10L)

2.1Distinguishing features of the group
2.2 Range of thallus organization.
2.3 Classification of Bryophyta according to G. M. Smith (1955) upto classes with reasons, giving at least two examples from each class.
2.4 Study of life cycle :*Riccia*&*Funaria w.r.t* Morphology, anatomy and reproduction (Development not expected).
2.5 Economic importance of bryophytes and Ecological significance of *Sphagnum*

Unit 3: Pteridophytes (10L)

3.1 Distinguishing features of the group
3.2 Classification of Pteridophytes according to G. M. Smith (1955) upto classes with reasons, giving at least two examples from each class.
3.3 Study of ancient plant *Rhynia* w.r.t. systematic Position and Morphology.
3.4 Study of life cycle: *Selaginella*&*Adiantum*w.r.t.Morphology, anatomy and reproduction(Development not expected).
3.5 Types of Steles.
3.6 Economic importance of Pteridophytes

Unit 4: **Gymnosperms** (7L)

4.1 Introduction and distinguishing features
4.2 Classification of Gymnosperms by K.R.Sporneupto order giving reason with suitable examples.
4.3 Study of life cycle: *Cycas*and *Pinus*. w.r.t.Morphology, anatomy and reproduction (Development not expected).
4.4 Economic importance.

Reference Books:

1. Kumar, H.D. (1999). Introductory Phycology.Affiliated East-West.Press Pvt. Ltd. Delhi.2nd edition.
2. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.

3. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
4. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
5. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot,Allahabad.

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Paper-II

Bot. 202: Plant Ecology

Total: 30 L

Aims and Objectives:

1 To know scope and importance of the discipline.
2 To study plant communities and ecological adaptations in plants.
3 To know about conservation of biodiversity.
4 To study the botanical regions of India and vegetationtypes of Maharashtra.

Unit 1: Introduction (2 L)

1.1 Definition and historical background
1.2 Scope & importance

Unit 2: Ecological factors

2.1. Abiotic factors (Humidity, light & temperature) (8 L)
2.2. Biotic factors (Symbiosis, epiphytes & parasitism)
2.3. Edaphic factors (Soil components, soil formation and soil profile)
2.4 Shelford law of tolerance
2.5 Adaptation of hydrophytes (*Hydrilla*&*Eichhornia*) and Xerophytes (*Nerium*&*Opuntia*)

Unit 3: Plant communities (5 L)

3.1 Characteristics of community
3.2 Species diversity
3.3 Growth form, Structure & dominance.
3.4 Ecological Succession: Hydrosere andXerosere

Unit 4: Ecosystem (10L)

4.1 Introduction & definition
4.2 Components of ecosystem
4.3 Types of ecosystem
a) Pond ecosystem
b) Grassland ecosystem
4.4 Food chain and food webs.
4.4 Ecologicalpyramids production and productivity.
4.5 Biogeochemical cycle: Carbon and Nitrogen

Unit 5: Phytogeography (5 L)

5.1 Basic Principles of Phytogeography
5.2Botanical regions of Inida
5.2 Vegetational types in Maharashtra
5.3Endemism: Causes and Types

Reference Books:

1) Agrawal, K. C. (1996) Environmental Biology, Agro-Botanical Publisher, Bikaner India.
2)Ambasta, R. S. (1990) Environmental and pollution, Student's friends and co.

Varanasi, India
3) Ambasta, R. S. (1988)A Text Book of Plant Ecology, Students Friends and co. Varanasi, India.
4) Dash, M. C. (1993) Fundamentals of Ecology, Tata MaGrow Hill, Publishing co. Ltd., New Delhi, India
5) Kumar, H. D. (1997) General Ecology, Vikas Publising House,(P) Ltd., New Delhi, India
6) Odum, E. P. (1996) Fundamental of Ecology, Natraj Publishers, Dehra-dun, India
7) Sharma, P. D. (2010) Ecology and Enivornment 8th ed. Rastogi Publication, Meerut, India
8) Kapur, P. and Govil, S. R. (2000) Experimental Plant Ecology. S. R. Jainfor, CBS, Publisher and Distributors, New Delhi, India.
9) Kormondy, E. J. (1996) Concepts of Ecology, 4th ed. Prentice Hall, U.S.A.
10) Mishra, R. and G.S. Puri,(2012) Indian Manual of plant Ecology. Scientific Publishers (India)
11) Moore, P. W. and S. B. Chapman (1986) Method in Plant Ecology. Blackwell Scientific Publication.
12) Kochhar, P. L. Plant Ecology, Genetic and Evolution, S. Nagin and Co. Ltd., New Delhi, India.
13) Nath, Ravindra(1992)Modern College Botany, IInd Edition, Kalyani Publisher, New Delhi, India.
14. Patil C.R.,PataskarP.G., Nagraja T.G.&Sathe S. S.(2004) Plant Physiology & Ecology, PhadakePrakashan, Kolhapur.
15. Verma, V. (1988) A Text Book of Plant Ecology, Emkay Publication, Delhi.

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Paper III
Bot. 203: Practical
(Based on Bot.201 and Bot.202)

1. **Study of *Riccia*:**Systematic Position,External &Internal morphology
    a) Mounting of rhizoids & scales
    b) T. S. of Thallus
    c) V. S. ofantheridia [P. S.]
    d) V.S.of archegonia [P.S.]
    e) V.S.of sporophyte [P.S.]
2. **Study of *Funaria*:**Systematic Position,External & Internal morphology
    a) T. S. of axis [P.S.]
    b) V.S. antheridial head [P.S.]
    c) V.S.ofarchegonial head [P.S.]
    d) V.S.of Capsule [P.S.]
3. **Study of *Selaginella*:** Systematic Position,External & Internal morphology
    a) T. S. of Stem
    b) Mounting of sporangia
    c) V. S. of Strobilus [P. S.]
4. **Study of *Adiantum*:** Systematic Position,External & Internal morphology
    a) T. S. of Rachis [P. S.]
    b) T. S. of Sorus [P. S.]
5. **Study of *Cycas*:** Systematic Position,External & Internal morphology
    a) T. S. of Rachis
    b)T. S. of leaflet
    c) Male cone microsporophyll [P. S.] OR Specimen
    d) Female cone megasporophyll [P. S.] OR Specimen
    e) V. S. of Ovule [P. S.]
6. **Study of *Pinus*:**Systematic Position,External & Internal morphology
    a) T. S. of Needle
    b) Mounting of pollen grain
    c) T. S. of Stem [P.S.]
    d) Male cone, microsporophyll [P. S.] OR Specimen
    e) Female cone, megasporophyll [P. S.] OR Specimen
    f) V. S. of Ovule [P. S.]

7.Demonstration, working and uses of the following ecological instruments.
    a) Soil thermometer
    b) Maximum and minimum thermometer
    c) Cup anemometer
    d) Hair hygrometer
    e) Rain Gauge

8. Determination of pH and analysis of two soil samples for carbonates, Nitrates &sulphates.

9. Study of morphological adaptations of hydrophytes and xerophytes (One each).

10. Study of biotic interactions with suitable example: Stem parasite , Root parasite, Epiphytes , Insectivorous plants.

11. Determinethe frequency & density of herbaceous vegetation by listcountquadratemethod.

12. Field visit.

Note: *1. Submission of any five plants from Archegoniates*

2. Tour report.

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FACULTY OF SCIENCE & TECHNOLOGY

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

‘A’ Grade
NAAC Re-Accredited
(3^{rd} Cycle)

SYLLABUS
FOR
S. Y. B. Sc. (PHYSICS)

(AS PER CHOICE BASED CREDIT SYSTEM PATTERN OF UGC)

(With effect from June - 2019)

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process and examination and evaluation systems.

In that context in the last decade, North Maharashtra University, Jalgaon has taken several initiatives to upgrade and enhance the academic excellence, examination reforms and developing the skilled minds and skilled hands. As per the directions of UGC, from last year our KBC North Maharashtra University, Jalgaon has implemented the Choice Based Credit (CBCS) pattern to undergraduate programs run by various colleges affiliated to NMU, Jalgaon. As per the directions given by the Honorable Vice Chancellor, Pro-Vice Chancellor and Dean of the Faculty of Science and Technology of our university, one day workshop was organized for syllabus framing. The teachers of the affiliated colleges and university department were participated in the workshop of re-structuring the syllabi of S.Y.B.Sc. (Physics) as per the CBCS pattern and it has been finalized during the workshop and the same will be effectively implemented from the academic year 2019-20.

The main objective of the re-structuring the syllabus of S.Y.B.Sc. (Physics) is to create skilled minds and therefore expectation is to equip the students with the knowledge and understanding of concepts of physics rather than the ability to remember facts so that they may have a reasonable comprehensive and complete grasp of principles of physics. It is expected that the students should study physics with keen interest, develop their experimental skill and problem solving ability. The students should communicate their knowledge of Physics to the Society, to make them to understand physics around us. The students should use their knowledge of Physics for betterment of our Society, our nation and the World.

Board of Studies (Physics),
North Maharashtra University, Jalgaon

OBJECTIVES

1. To provide education in physics of the highest quality at the undergraduate level and generate graduates of the caliber sought by industries and public service as well as academic teachers and researchers of the future.
2. To acquire deep knowledge in fundamental aspects of Physics and basic knowledge in the specialized thrust areas like Thermodynamics, Basic electronics, Waves, Sound, Optics, LASERS, Energy harvesting and electrical circuit skills.
3. To develop ability among the students to identify, remember and grasp the meaning of basic facts, concepts and principles of Physics.
4. To develop observational skills, confidence in using scientific equipment and relate the knowledge of scientific concepts to quantitative and physical measurement.
5. Acquire knowledge, skills, working methods and ways of expression which will reflect on all round development of the students' attitudes towards scientific thinking and its applications.
6. To develop attitudes such as concern for accuracy and precision, objectivity, and Enquiry.
7. The overall aim is to provide comprehensive knowledge and understanding in the relevant fields and enable students to pursue the physics subject at an advanced level later and to attract outstanding students from all back grounds.

BOS (PHYSICS)-Faculty of Science & Technology

Kavayitri bahinabai Chaudhari

North Maharashtra University, Jalgaon

Class: **S. Y. B. Sc.** Subject: **Physics**

Choice Base Credit System (With effect from June 2019)

The Board of Studies in Physics in its meeting held on **4th July 2018** has unanimously accepted the revised syllabus (as per CBCS pattern) prepared by different committees, discussed and finalized in workshop restructuring of S.Y.B.Sc. Syllabus.

The titles of the papers for S.Y.B.Sc. (Physics) are as given below:

Semester	Course		No. of Credits	Hours per semester	Marks	
	Course code	Course Title			Internal marks	External marks
III	PHY 301	Thermodynamics and Kinetic theory of gases	02	30	40	60
	PHY 302(A) OR PHY 302(B)	Electronics-I OR Instrumentation	02	30	40	60
	PHY 303	LAB-III	02	60	40	60
	PHY 304: (Skill Enhancement course I)	Renewable energy and Energy Harvesting	02	30	40	60
IV	PHY 401	Waves, Oscillations and acoustics	02	30	40	60
	PHY 402	Optics and LASERS	02	30	40	60
	PHY 403	Lab IV	02	60	40	60
	PHY 404: (Skill Enhancement course II)	Electrical Circuits and Network Skills	02	30	40	60

Note: The industrial/study tour is compulsory for students of S. Y. B. Sc. (Physics).

Semester III: Physics paper I

PHY 301: Thermodynamics and Kinetic theory of gases

(Credits: 02) :(30 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Thermodynamics and kinetic theory of gases to Under Graduate students.

Course objectives:
1. To impart knowledge of basic concepts in Thermodynamics and kinetic theory of gases.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….
1. Apply the concept of use of knowledge of Thermodynamics and kinetic theory of gases to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Basics of thermodynamics and its First Law: (08 L, 15 M)
Thermodynamic Description of system, Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes.

Unit 2: Second and Third Law of Thermodynamics and Entropy: **(08 L, 15 M)**
Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible and irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero, Enthalphy.

Unit 3: Heat Engines: (07 L, 15 M)
Carnot's Engine, Otto Engine and Cycle, Diesel Engine and Cycle, Efficiencies of all heat engines.

Unit 4: Kinetic Theory of Gases: (07 L, 15 M)
Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

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Reference Books:

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M. W. Zemasky and R. Dittman, 1981, McGraw Hill 13
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears & G. L. Salinger. 1988, Narosa
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications

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Semester III: Physics paper II
PHY 302 (A): Electronics –I
(Credits: 02) :(30 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Electronics of gases to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

…….

Unit 1 Semiconductor diodes **(07 L, 14 M)**

(Revision on metal, insulator and semiconductors, Intrinsic and Extrinsic semiconductor), Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. PN junction and its characteristics. Static and Dynamic Resistance. Principle, Construction, Working and Characteristics of (1) LEDs (2) Photodiode (3) Solar Cell (P-N Junction), (4) Zener Diode

Unit 2: **Rectifiers and Power Supplies** **(05 L, 10M)**

Introduction to Rectifiers, Types: Half-wave & Full-Wave Rectifiers (Centre-tapped and Bridge Rectifiers), Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, D.C. power Supply (unregulated and regulated), Zener Diode as a voltage regulator.

Unit 3: Bipolar junction transistor **(06L, 12M)**

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC configurations. Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q point.

Unit 4: Digital Electronics **(12 L, 24 M)**

Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, Binary Addition, Binary Subtraction using 2's Complement Method, AND, OR and NOT Gates (Realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates,

De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra, Fundamental Products, Min terms and Max terms, Conversion of a Truth Table into an Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh's Map,

Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.

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Reference Books:

1. Electronic Principles – A. P. Malvino, Mc Graw-Hill Publishing House
2. Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition
3. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi
4. Electronic Devices and Circuits – Allen Mottershead, Good year Publishing Company
5. Digital Principles and Applications – Malvino and Leach, Mc Graw-Hill Publication.
6. Modern Digital Electronics – R. P. Jain, Tata Mc Graw-Hill Pvt. Ltd., New Delhi
7. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
8. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
9. Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
10. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
11. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.

Semester III: Physics paper II
PHY 302 (B): Instrumentation
(Credits: 02) :(30 Lectures 60 Marks)

[Note: For students opting electronics as one of the subjects at F. Y. B. Sc. Class]

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Course description:
This course is aimed at introducing the fundamentals of Instrumentation to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Instrumentation.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….

1. Apply the concept of use of knowledge of Instrumentation to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit-I Fundamentals of Measurements: (04L, 8M)
Functional elements of typical measurement system, Standards of measurements and calibration, Static performance characteristics: Accuracy, Precision, Accuracy versus precision, Sensitivity, Linearity, Concept of Errors and their types.

Unit-II Measurement of Temperature: (10L, 20M)
Non - electrical Methods : Liquid- in-glass Thermometer, Pressure Thermometer construction and their types: constant volume gas thermometer and Vapour pressure Thermometer, **Electrical Methods :** Thermo-electric Sensors (Thermocouple), Metallic resistance Thermometer (Platinum resistance thermometer), Semiconductor resistance sensors (Thermistor).
Radiation Methods (Pyrometry) : Total Radiation Pyrometer, Selective Radiation Pyrometer.

Unit-III: **Measurement of Pressure: (08L, 16M)**
High pressure Measurement, Measurement of low pressure (Vacuum): McLaud Guage, Pirani Gauge, Calibration & Testing (Dead - weight tester)

Unit-IV: Acoustics (Sound) Measurement: (08L, 16M)
Characteristics of sound, Sound pressure level, Sound power level, Variation of intensity of sound with distance, Typical sound measuring system (Sound level Meter), Microphones : Condenser or capacitor type Microphone, Electrets Microphone, Electrodynamics types of Microphone, Carbon granules type Microphone

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Reference Books :

1. Instrumentation, Measurement & Analysis by (Nakra and Chaudhary), 2nd Edition
2. Instrumentation : Devices & Systems by (Rangan, Mani & Sarma), 2nd Edition
3. Basic Electronics by B. L. Thereja.
4. A Course In Electrical & Electronics Measurement & Instrumentation by A. K. Sawhney
5. Modern electronic instrumentation and Measurement Techniques by Helfrick & Cooper.

Semester III: Physics paper III:

PHY 303: Lab III

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

(Note: Total 10 experiments should be performed. Minimum 05 experiments from both sections should be performed.)

Section A: General Physics-I

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the mechanical equivalent of heat (J) with the help of Joules calorimeter.
3. To determine the coefficient of thermal conductivity of a bad conductor by Lee's method and Charlton's disc method.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine thermal conductivity of rubber by tubing method.
7. To determine thermal conductivity of metal by Forbe's method.
8. To Verify Clausius-Clapeyron equation.
9. Jolly's steam calorimeter.
10. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
11. To study the variation of thermo e. m. f. across two junctions of a thermocouple with temperature.
12. Stefan's fourth power law using bulb.
13. To determine angle of prism and familiarization with Schuster`s focusing.
14. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
15. To determine Dispersive Power of the Material of a given Prism using Mercury Light.
16. To determine Stefan's constant.

Section B: Electronics

1. Study of full wave rectifier with capacitor filter and to calculate its ripple factor.
2. Study of zener diode as a voltage regulator.
3. Study of CE transistor characteristics to find out 'β' of the transistor.
4. Study of logic gates (AND, OR and NOT) using diodes and transistors.
5. Verification of De Morgan's Theorems (using ICs).
6. To study the characteristics of Light Emitting Diode (LED).
7. Experimental verification of NAND gate as a universal building block.
8. Experimental verification of NOR gate as a universal building block.
9. To study I – V characteristic of (i) a resistor and (ii) a p–n junction diode and compare it.
10. Frequency response of CE single stage transistor amplifier and to calculate its bandwidth.
11. To determine fill factor and efficiency of solar cell.
12. Comparison of luminous intensities of two light sources by using photo voltaic cell.

OR Section B: Instrumentation

1. Use of C.R.O as a measurement tool for different electrical parameters (frequency, a.c. /d.c. voltage, pulse height, pulse width, rise time and fall time).
2. To obtain Lissajous figures using C.R.O.
3. To determine characteristics of Thermistor and to find an unknown temperature by using thermistor.
4. Use of thermocouple for measurement of temperature.
5. Measurement of errors.
6. Directional characteristics of a microphone.

7. Platinum resistance thermometer. (Determine the melting temperature of Wax)
8. Velocity of sound by phase shift method.
9. Measurement of Noise by Using Sound Pressure level Meter.

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Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
5. A text Book of Experimental Physics – Dr. V.Y. Rajopadhye, V.L.Purohit and A. S. Deshpande (Continental Prakashan, Poona-30).
6. AN ADVANCED COURSE IN PRACTCIAL PHYSICS- D. Chattopadhyay and P.C. Rakshit.
7. Practical Physics by R. K. Shukla, Anchal Srivastava (New Age International).
8. B.Sc. Practical Physics by Harnam Singh and Dr. P.S. Hemne (S. Chand).
9. Advance Practical Physics by S.P.Singh (Pragati).
10. College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi)
11. Practical Physics: Gupta and Kumar (Pragati Prakashan Meerat)
12. Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS)
13. A Text book of practical Physics: Shrinivasan and Balasubranian
14. A Text book of practical Physics: Indu Prakash and Ramkrishna.
15. B.Sc. Practical Physics by C.L. Arora (S. Chand and Co. Ltd , Delhi)
16. Practical Course in Electronics by Prof. J.R.Patil and other (Jaydeep Prakashan).

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Semester III: Physics paper IV

PHY 304: Skill Enhancement Course I (SEC-I)

Renewable energy and Energy Harvesting (Credits: 02) Theory: (30 L, 60M)

[The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible]

Unit 1.Conventional and Non-conventional energy Sources: Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. **(02L, 04M)**

Unit 2 . Solar Energy

Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems. Solar energy utilization by Solar roof panels. **(06 L,12 M)**

Unit 3. Ocean, geothermal, Hydro and Biomass energy resources.

a. **Ocean Energy**: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. **(03 L,06M)**
   Tidal energy,Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power. **(02 L,04M)**

b. **Geothermal Energy**: Geothermal Resources, Geothermal Technologies. **(02 L,04M)**

c. **Hydro Energy**: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. **(02 L, 04M)**

d. **Biomass energy:** biomass, biochemical conversion, biogas generation, Ocean biomass **(02L,04M)**

Unit 4. Energy Harvesting:

a. **Wind Energy harvesting**: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies **(03 L,06M)**
b. **Piezoelectric Energy harvesting**: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power
   (04 L,08M)
c. **Electromagnetic Energy Harvesting**: Linear generators, physics mathematical models, recent applications, **(02 L,04M)**
d. Carbon captured technologies, cell, batteries, power consumption **(01 L,02M)**
e. Environmental issues and sustainability of renewable energy sources,. **(01 L,02M)**

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Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of mechanical energy (vibration) into voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

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Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhatme Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. http://en.wikipedia.org/wiki/Renewable_energy

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Semester IV: Physics paper V

PHY 401: Waves, Oscillations and Acoustics

(Credits: 02) : (30 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Waves and Sound to Under Graduate students.

Course objectives:
1. To impart knowledge of basic concepts in Waves and Sound.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….

1. Apply the concept of use of knowledge of Waves and Sound to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit I: Composition of two S. H. M.'s
Composition of two S.H.M.s of equal frequencies along same line (co-linear) of vibration (analytical method only), Composition of two S.H.M.s of equal frequencies acting at right angles (analytical method with different cases), Composition of two S.H.M.'s right angles to each other (time period in the ratio 1:2), Lissajous figures- demonstration by mechanical, optical and electrical methods, applications of Lissajous figure (list only). **(06L, 16M)**

Unit II: Waves Motion
General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Plane waves, Spherical waves, Wave intensity. **(05L, 8 M)**

Unit **- III: Forced oscillations**
Idea of forced oscillations, Resonance and its types- Mechanical resonance (Barton's pendulum), Acoustic resonance (resonance tube), Electrical resonance (LCR circuit) and Optical resonance (sodium vapour lamp), Differential equation of forced oscillations and its solution, Amplitude of forced oscillations, Amplitude resonance, Application to series L-C-R circuit. **(08L, 16M)**

Unit IV: Sound:
Parameters of Sound: Sound intensity, Loudness, Pitch, Quality and timber, Acoustic intensity level measurement, Acoustic pressure and its measurement. Reverberation and time of reverberation.
Ultrasonics: Classification of sound frequencies, Piezoelectric effect, Generation of ultrasonic waves by Piezoelectric oscillator (using transistor), Application of ultrasonic waves (list only).
Doppler effect: Doppler effect in sound, Expression for apparent frequency (no derivation), discussion of different cases when source, observer and medium are in relative motion, Asymmetric nature of Doppler effect in sound, Doppler effect in light, Symmetric nature of Doppler effect in light, Applications of Doppler effect in sound and light. **(11L, 20M)**

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Reference Books:

1. Waves and oscillations- Brijlal and Subramaniyam (Vikas Publishing House)
2. Waves and Oscillations- R.N. Chaudhari, New Age International (Pvt.) Ltd.
3. Conceptual Physics- A. P. Taggarase, Jivan Sheshan (Himalaya Publishing).
4. The Physics of Waves and Oscillations- N. K. Bajaj (Tata McGraw Hill).
5. Oscillations and Waves- B. S. Agarwal (KedarNath, Ram Nath Publishers)
6. Sound- Mee and Heinmann, London Edition

Semester IV: Physics paper VI

PHY 402: Optics and LASERS

(Credits: 02) : (30 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Optics and LASERS to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Optics and LASERS.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of Optics and LASERS to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit I: Geometrical Optics: Deviation produced by thin lenses, equivalent focal length of two thin lenses separated by a distance and when in contact. Power of lens, Spherical aberration in lens, reduction of spherical aberration (without derivation), Chromatic aberration, Achromatism; (two lenses in contact and separated by finite distance without derivation). **(04L, 10M)**

Unit II: Interference: Principle of superposition of two, Concept of interference, Intensity distribution in the interference pattern, Division of amplitude and division of wavefront. Young's Double Slit experiment, Expression for fringe width, Fresnel's Biprism and Lloyd's Mirror. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). fringe width in case of fringes of equal thickness. Newton's rings-experimental setup, theory and its application to determine wavelength of source and refractive index of liquids **(10L, 20M)**

Unit III : Diffraction: Definition of diffraction, Concept of diffraction, Types of diffraction, Fresnel Diffraction: Half-period zones, Zone plate, Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis, Fraunhofer diffraction: Single slit; Double Slit. Multiple slits and Diffraction grating. **(08L, 14M)**

Unit IV: Polarization: Polarization, Polarization by reflection, Brewster's law, Polarization by double refraction in uniaxial crystals, Maluss Law Double refracting crystals, Positive and negative crystals, Production and detection of circularly and elliptically polarized light, Nicol prism, Optical activity, Rotation of the plane of polarization, Specific rotation, Polarimeter or Sacherimeter, (Principle and working). **(04L, 10M)**

Unit V: Non-linear optics: Principle of LASER, Characteristics of LASER, Basic steps required to form a LASER: absorption, spontaneous emission, stimulated emission, Metastable state, population inversion, optical pumping, Types of LASER- He-Ne LASER, Applications of LASER (list only) **(04L, 06M)**

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Reference Books:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication
4. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986.Addison-Wesley
5. Lasers and nonlinear optics – B. B. Laud
6. An Introduction to Laser – Theory and applications – M. N. Avadhanale
7. A textbook of Optics: Dr. N. Subrahmanyam, Brijlal and Dr. M.N.Avadhanulu, S.Chand Publishing,Co.Ltd.
8. Optics: Singh and Agrwal, Pragati Prakashan, Meerut.
9. Optics and Thermodynamics- Sarkar and Sharma, Himalaya Publishing House

Semester IV: Physics paper VII:

PHY 403: Lab IV - General Physics II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

(Note: Total 10 experiments should be performed.)

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ_2 – T Law.
3. To study Lissajous Figures and demonstration of Lissajous figures by using C.R.O.
4. Study of acoustic resonance by using bottle as a resonator.
5. Determination of velocity of sound by using Kundt's tube.
6. Study of resonance using Kater's pendulum.
7. Log decrement
8. Damping coefficient
9. Study of acoustic resonance by using resonance tube.
10. To determine the Resolving Power of a Prism.
11. To determine the value of Cauchy Constants of a material of a prism.
12. To determine wavelength of sodium light using Fresnel Biprism.
13. To determine wavelength of sodium light using Newton's Rings.
14. To determine the refractive index of a liquid by using Newton's rings apparatus.
15. Determination of specific rotation α of optically active substance using Polarimeter.
16. Measurement of beam size of a LASER beam.
17. Measurement of beam divergence of a LASER beam.
18. To determine the wavelength of light from LASER source using Diffraction grating.
19. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
20. To determine the Resolving Power of a Plane Diffraction Grating.
21. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

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Reference Books:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
4. B.Sc. Practical Physics: C. L. Arora, S. Chand Publishing Co. Ltd., New Delhi

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Semester IV: Physics paper VIII

PHY 404: Skill Enhancement Course II

Electrical Circuits and Network Skills

(Credits: 02) : (30 Lectures 60 Marks)

[The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode]

Unit 1. Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter. **(03 L, 06 M)**

Unit 2. Understanding Electrical Circuits: Main electric circuit elements (R,L,C) and their combination. Rules to analyze DC sourced electrical circuits (KCL, KVL) Current and voltage drop across the DC circuit elements, Diode and rectifiers, . Response of inductors and capacitors with DC or AC sources Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components AC source. Power factor. Saving energy and money. **(07 L, 14 M)**

Unit 3. Electrical Drawing and Symbols: Drawing symbols. Blueprints. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop. **(04L, 08M)**

Unit 4.Generators and Transformers: Types of DC Power sources. Principle of DC/AC generators, construction of DC generator, Operation of transformers. **(03 L, 06 M)**

Unit 5.Electric Motors: Single-phase AC & DC motors (Basic design). Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **(04 L, 8 M)**

Unit 6.Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) **(04L, 08 M)**

Unit 7.Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board. **(05 L, 10 M)**

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Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.
4. Electrical Technology by V.K.Meheta

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KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

SYLLABUS FOR CORE AND SKILL ENHANCEMENT COUESES IN BOTANY

As Per U. G. C. Guidelines

Based on

Choice Based Credit System (CBCS)

S. Y. B. Sc. BOTANY SEMESTER-WISE SYLLABUS

(Theory and Practicals)

Semester-III

Bot. 301: Plant Anatomy

Bot. 302: Plant Physiology

Bot. 303: Practical Based on Bot: 301 and Bot: 302

Bot. 304: Mushroom Culture Technology

Semester-IV

Bot. 401: Plant Embryology

Bot. 402: Plant Metabolism

Bot. 403: Practical Based on Bot: 401 and Bot: 402

Bot. 404: Nursery and Gardening

w. e. f. June, 2019

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Structure of S.Y. B.Sc. Botany Syllabus under CBCS Pattern

w.e.f. June, 2019

Year	Sem.	Paper	Code	Title of Course	Marks		Credits
					Int.(CA)	Ext.(UA)	
II	III	I	Bot. 301	Plant Anatomy	40	60	2
		II	Bot. 302	Plant Physiology	40	60	2
		III	Bot. 303	Practical (LAB – I)	40	60	2
		IV	Bot. 304	Mushroom Culture Technology (SEC)	40	60	2
	IV	I	Bot. 401	Plant Embryology	40	60	2
		II	Bot. 402	Plant Metabolism	40	60	2
		III	Bot. 403	Practical (LAB – I)	40	60	2
		IV	Bot. 404	Nursery and Gardening (SEC)	40	60	2

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus of S.Y.B.Sc. Botany w.e.f. June, 2019

CBCS Pattern

Semester: III

PAPER-I

BOT. - 301: PLANT ANATOMY

Lectures: 30

AIMS AND OBJECTIVES

1. To know scope and importance of plant anatomy
2. To study various tissue systems
3. To know primary structure of dicot and monocot plants
4. To study normal secondary growth in plants and their causes
5. To study protective tissue system

Unit-1: **Introduction** **02 L**

1.1 Definition, Scope and Importance

Unit- 2: **Plant Tissues** **08 L**

2.1 Definition

2.2 Meristematic tissues: Classification based on position and origin

2.3 Tissues and it's types:

(a) Simple tissues:

i) Parenchyma: Arenchyma, Chlorenchyma and Palisade

ii) Collenchyma

iii) Sclerenchyma: Fiber and Sclereids / Stone cells

(b) Complex tissues:

i) Xylem and its elements

ii) Phloem and its elements

Unit-3: Protective Tissue System **07 L**

3.1 Epidermal Tissue System: Definition and Function

3.2. Types of Epidermal Appendages

a) Unicellular, Multicellular (Uniseriate and Multiseriate) Trichomes

b) Glandular, Non-glandular Trichomes

c) Stellate, Dendroid Trichomes and Peltate scales

3.3 Types of Stomata

i. Ranunculaceous (Anomocytic)

ii. Cruciferous (Anisocytic)

iii. Rubiaceous (Paracytic)

iv. Caryophyllaceous (Diacytic)

v. Graminaceous

Unit-4: **Primary Structure** **08 L**

4.1 Dicotyledonous (Sunflower)

i. Root

ii. Stem

iii. Leaf

4.2 Monocotyledonous (Maize)

i. Root

ii. Stem

iii. Leaf

Unit- 5: Secondary Growth **05L**

5.1 Vascular cambium- Structure and function, seasonal activity

5.2 Secondary growth in root and stem of Sunflower

5.3 Wood- Heartwood and sapwood

REFERENCES:-

1) Carlquist, S. (1961) Comparative Plant anatomy. Hold, Rinehart and Winson, New York, USA.

2) Chandurkar, P.J, (1971) Plant Anatomy (3rd Ed.), Oxford and IBH Publishing Co. New Delhi and Bombay, India.

3) Choyal Rajaram (2012) Plant Anatomy and Physiology, Sonali Publications, New Delhi, India.

4) Cutter, E. G. (1971) Plant Anatomy: Experiment and Interpretation Part-II, Organ. Edward Arnold, London, UK.

5) Das Susheela, M. (2017) A Text Book of Plant Anatomy. Dominant Publishers and Distributers Pvt. Ltd., New Delhi, India.

6) Eames, A.J. and L.H. Mc Daniels (1947) An Introduction to Plant Anatomy, (2nd Ed.).McGraw Hill Co. New York, USA.

7) Esau, K. (1977) Anatomy of Seed Plants (2nd Ed.).John Wiley, New York, USA.

8) Fahn, A. (1982) Plant Anatomy (3rd Ed.) Pergman Press, Oxford and New York. USA.

9) Grewal, R.C. (2011) Plant Anatomy. Campus Books International, New Delhi, India.

10) Mauseth, J.D. (1988) Plant Anatomy. The Benjamin/Cummings Publisher, USA.

11) Menan , A.B. (2008) Introduction to Plant Anatomy. Rajat Publications, New Delhi, India.

12) Pandey, B.P. (1954) Plant Anatomy. S. Chand and Co. (P.) Ltd. New Delhi, India.

13) Pandey, S.N. and A. Chadha (2006) Plant Anatomy and Embryology. Vikas Publishing House Pvt., Ltd., New Delhi, India.

14) Sharda, Tarun P. (2012) An Introduction to Plant Anatomy. Alfa Publications, New Delhi, India.

15) Sharma Rajani (2009) An Introduction to Plant Anatomy. Campus Books International, New Delhi, India.

16) Singh Sanjay Kumar ((2005) Text Book of Plant Anatomy. Campus Books International, New Delhi, India.

17) Singh, S. K., and Seema Srivastava (2011) Anatomy of Angiosperm. Campus Books International, New Delhi, India.

18) Singh, V., P.C. Pande and D.K. Jain (1998) Anatomy of Seed Plants. Rastogi Publications, Meerut, India.

19) Singh, V., P. C. Pande and D.K. Jain (2013) A Text Book of Botany Angiosperm. Rastogi Publications, Meerut, India.

20) Tandan Neeraj (2014) An Introduction to Plant Anatomy. Anmol Publications, Pvt., Ltd., New Delhi, India.

21) Tayal, M.S. (1994) Plant Anatomy. Rastogi Publications, Meerut, India.

22) Vashista, P.C. (1986) Plant Anatomy. Pradeep Publications, Jalandhar, India.

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PAPER – II

BOT.302: PLANT PHYSIOLOGY

Lectures: 30

AIMS AND OBJECTIVES

1. To know importance and scope of plant physiology.
2. To study plant and plant cell in relation to water.
3. To study different process in relation with structure of organism and its environment.
4. To understand mechanism of absorption of water, gases and solutes.
5. To understand growth at various level.

Unit: 1.Introduction **01 L**

1.1 Definition, scope and importance of plant physiology.

Unit: 2. Plant cell and water relation **05 L**

2.1 Diffusion, Definition, mechanism of diffusion with suitable example, Diffusion Pressure, Graham's law of diffusion and significance of diffusion.

2.2 Osmosis: Introduction, definition, mechanism of osmosis with suitable Osmometer, osmotic pressure, turgor pressure and wall pressure, DPD and its relation with OP, TP, and WP. Types of solution- Hypotonic, Hypertonic and Isotonic. Type of Osmosis- Exosmosis and Endosmosis, significance of osmosis , Plasmolysis, de-plasmolysis.

2.3 Imbibition**:** Definition, mechanism, imbibition pressure, Importance of imbibition.

Unit: 3. Absorption of water **05 L**

3.1 Importance of water.

3.2 Mechanism of water absorption.

a. Active absorption- Osmotic theory and non-osmotic theory.

b. Passive absorption.

3.3 Factors affecting water absorption.

Unit: 4. Ascent of Sap **05 L**

4.1 Introduction and definition

4.2 Theories of ascent sap.

a. Vital theories

b. Root pressure theory.

c. Physical force theories

d. Transpiration pull theory.

Unit: 5. Transpiration **05 L**

5.1 Definition, Magnitude and types of transpiration, Structure of stomata, mechanism of opening and closing of stomata.

5.2 Theories of stomatal opening and closing.

a. Theory of Starch- Glucose interconversion and stomatal opening in Succulent plants(Steward's Theory)

b. K^+ pump theory.

5.3 Factors affecting rate of transpiration.

5.4 Significance of transpiration.

Unit: - 6. Mineral nutrition and absorption of mineral salt **05 L**

6.1 Introduction, essential and non essential elements, Macro and micro nutrient elements.

6.2 Specific functions and deficiency symptoms of- Nitrogen, Sulphur, Phosphorus, Potassium, Magnesium and Boron.

6.3 Mechanism of mineral salt absorption.

a) Passive absorption- Mass flow theory, Ion exchange and Donnan's equilibrium.

b) Active absorption- Carrier concept theory- Protein lecithin as carrier.

Unit: 7 .Plant growth and Phytohormones **04 L**

7.1 Introduction, Definition of growth, Development and Differentiation

7.2 Definition of Phytohormones and role of Auxins, Gibberellins, Cytokinins, Ethylene and Abscisic acid.

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REFERENCES:-

1. Amar Singh (1977) Practical Plant Physiology. Kalyani Publication, New Delhi, Ludhiana, India.

2. Jain. V.K. (1977) Fundamentals of plant physiology. S. Chand and Company Ltd. New Delhi, India.

3. Kochhar. P. L. (1962) A Text Book of Plant Physiology, Atmaran and Sons, New Delhi, India.

4. Kumar, A. and S.S. Purohit (1998) Plant Physiology, Fundamentals and Application. Agro Botanical, Bikaner, India.

5. Meyer. B.S and D.B. Anderson (1952) Plant Physiology Affiliated East-West Press Pvt. Ltd., New Delhi, India.

6.Mukharji and Ghosh A.K. (1996) Plant Physiology. Tata McGraw-Hill Publishing company Ltd. New Delhi, India.

7.Pandey and Sinha (1999) Plant Physiology. Vikas Publishing House Pvt. Ltd. New Delhi, India.

8. Sarabhai, B.P. (1995) Elements of Plant Physiology. Anmol Publication Pvt. Ltd, New Delhi, India.

9.Srivastava. H.C (1994) Plant Physiology, Rastogi Publication, Meerut, India.

10.Sundara Rajan (2000) College Botany (Plant Physiology and Molecular Biology Vol.IV, Himalaya Publishing House, New Delhi, India.

11.Varma, V. (1984) Introduction to Plant Physiology. Emkay Publication, New Delhi, India.

12.Varma V. (1995) A Text Book of Plant Physiology and Biochemistry. S. Chand and Company. New Delhi, India.

13.Taiz, L. Zeiger E. (2010) Plant Physiology. Sinauer Associates Inc.; U.S.A. 5th edition.

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PAPER- III

BOT. 303:Practical (Based on BOT. - 301 and BOT. - 302)

Practical No.1&2

i) Study of meristem (Permanent slides/ Photographs).

ii) Study of Simple Tissues:
Parenchyma, Collenchyma and Sclerenchyma (Permanent Slides/ Photographs)

iii) Macerated xylem and phloem elements (Permanent slides/ Photographs).

iv) Study of dicot leaf(Sunflower) and monocot leaf (Maize) (permanent slides.)

Practical No: 3 and 4: Study of primary structure of dicot stem (Sunflower) and monocot stem (Maize).

Practical No.5: Study of primary structure of dicot root (Sunflower) and monocot root(Maize) (Permanent slides).

Practical No.6 and 7: Study of secondary growth structure in dicot stem and root (Sunflower)

Practical No. 8:

Study of trichomes (any three types) and stomata (any three types) with the help of locally available plant materials.

Practical No. 9: To determine DPD by using potato tuber.

Practical No.10: Determination of osmotic potential of plant cell sap by plasmolytic method.

Practical No. 11: To study the effect of two environmental factors (light and wind) on transpiration by excised twig.

Practical No.12and 13: Qualitative assessment of minerals in plant ash (any two from Macro and Micro elements)

Practical No.14. Demonstration experiments.

1. Osmosis by Curling experiment.
2. Osmosis-Thistle funnel experiment.
3. Bolting (Specimen or photograph)

Practical No.15. Demonstration experiments.

1. Suction due to transpiration.
2. Relative Transpiration.
3. Imbibition Pressure.
4. Ringing experiment.

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PAPER – IV

SKILL ENHANCEMENT COURSE (SEC)

BOT. 304: MUSHROOM CULTURE TECHNOLOGY

Lectures: 30

AIMS AND OBJECTIVES

1. To learn the history, scope and importance of mushroom technology
2. To understand nutritional and medicinal values of edible mushrooms
3. To know about the storage, marketing and various food preparations of mushrooms.
4. To understand the economics of mushroom cultivation.

Unit l: Introduction **05 L**

1.1: Scope and importance.

1.2: Nutritional and medicinal value of edible mushrooms.

1.3: Edible and non-edible mushrooms.

1.4: Morphology and distinguishing characteristics of following mushrooms:

a. Button (*Agaricus bisporus*)

b. Oyster (*Lentinus sajor-caju*, Syn. *Pleurotus sajor-caju*)

c. Paddy straw *(Volvariella volvacea*)

Unit 2: Cultivation Technology **15 L**

2.1: Mushroom farm layout and requirements

2.2. Materials for compost preparation, Different formulations, Selection of composting materials, Commonly used formulations, Synthetic compost and its advantages,

2.3: Spore culture and preparation of spawn.

2.4: Casing and its Importance, Quality parameters of casing mixture and commonly used materials for casing.

2.5: Cultivation procedure of: a. *Agaricus bisporus* *b. Pleurotus sajor-caju*.

Unit 3: Storage **04 L**

3.1: Short-term storage (Refrigeration - upto 24 hours)

3.2: Long term storage (canning, pickling). Drying, storage in salt solutions.

3.3: Marketing

Unit 4: Food Preparation **06 L**

4.1: Types of foods prepared from mushroom: Soup, Cutlet, Omlette, Samosa, Pickles, Curry.

4.2 Training Centres: National and Regional level.

REFERENCES:-

l. Marimuthu, T. Krishnamoofthl, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms. Department of Plant Pathology. TamilNadu Agricultural University, Coimbatore.

2. Swarninathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

3. S.C.Tewari. Pankaj Kapoor, (1988). Mushroom Cultivation, Mittal Publications. Delhi.

4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition. Vol.I and Vol. II.

5. Vijaya Khader (1993) Mushrooms for Livelihood. Kalyani Publishers. Pp170.

6. D. P. Tripathi (2005) Mushroom cultivation. Oxford IBH Publishing Co. Pvt. Ltd.Pp354.

7. S.C.Tiwari and Pankaj Kapoor. (1988) Mushroom Cultivation. Mittal Publications, Delhi. pp.-127

8. P.K. Khanna and S. Kappor (2007) Mannual of mushroom production. Dept. of Microbiology. College of Basic Sciences and Humanities, Punjab Agriculture University, Ludhiana. pp.86-90

9.Google.co.in

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Semester: IV

PAPER- I

BOT. - 401: PLANT EMBRYOLOGY

Lectures: 30

AIMS AND OBJECTIVES

1. To know the scope and Importance of Embryology
2. To study structure of micro and megasporangium.
3. To study pollination, fertilization, Endosperm and Embryogeny.
4. To give exposure of techniques in embryology

Unit 1: Introduction **01L**

1.1: Definition, Scope and importance of Embryology

Unit 2: Microsporangium (Anther) **04 L**

2.1: Structure of anther- Epidermis, endothecium, middle layer sporogenious tissue and Tapetum.

2.2: Tapetum types- a) Amoeboid or plasmodia b) Secretary or glandular

2.3: Functions of Tapetum

2.4: Microsporogenesis- karyokinesis and cytokinesis (simultaneous and successive)

2.5: Structure of pollen and Male gametophyte

2.6: Types of pollen tetrad – linear, isobilateral, tetrahedral, decussate, T- shaped.

Unit 3: Megasporangium (Ovule) **05 L**

3.1: Structure of Ovule.

3.2: Types of ovule: i) Orthotropous ii) Anatropous iii) Amphitropous iv) Hemianatropous v) Compylotropous vi) Circinotropous

3.3: Types of Embryo sac. i) Monosporic (*Polygonum*) ii) Bisporic (*Allium*) iii) Tetrasporic (*Peperomia*)

Unit 4: Pollination and Fertilization **05 L**

4.1: Definition and Types of Pollination: Anemophily, Entomophily, Hydrophily

4.2: Fertilization i) Definition ii) Entry of pollen tube into ovule - Porogamy, chalizogamy and mesogamy

iii) Process of double fertilization and tripl fusion

iv) Significance of double fertilization mechanism.

Unit 5: Endosperm **03L**

5.1: Definition.

5.2: Structure and function of endosperm.

5.3: Types of Endosperm. i) Nuclear ii) Cellular iii) Helobial.

Unit 6: Embryo **03L**

6.1: Definition

6.2: Structure of Dicot Embryo e.g. *Capsella brussa pastories* (Development not expected)

6.3: Structure of monocot embryo e.g. *Sagittaria* (Development not expected)

Unit 7: Seed structure and dispersal **06L**

7.1: Definition, structure of seed.

7.2: Appendages and dispersal mechanism of seed- Aril, Coma, Caruncle

7.3 Dispersal Mechanism:

i. By Wind - (Anemochory):

a. Winged seed and fruits b. Parachute mechanism c. Hairs

ii. By Water (Hydrochory): a. Floating devices b. Protective covering

iii. By Animal (Zoochory): a. Hooked fruits and seeds b. Sticky Fruit c. Edible fruit

Unit 8: Apomixis and polyembryony. **03L**

8.1: Apomixis: Definition and types – Non- recurrent, recurrent , adventive embryony and veg. reproduction

8.2: Polyembryony: Definition

8.3 Types of polyembryony: i. Simple ii. Cleavage iii Rosette

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REFERENCES:

1. Bhojwani, S.S. and S.P. Bhatnagar, (2013 Reprint) The Embryology of Angiosperms,

Vikas Publishing House Pvt. Ltd. New Delhi, India.

2. Maheshwari, P. (1950) An introduction to the embryology of Angiosperms, McGraw Hill Book Co. New York, USA.
3. Singh,V., P.C.Pandey and D.K. Jain(1998) Embryology of Angiosperm , Rastogi Publications, Meerut, India
4. Singh,V., P.C.Pande and D.K. Jain(2004) Structure ,Development and Reproduction in Angiosperm (2nd Ed.) Rastogi Publications, Meerut.
5. Singh, Sanjay Kumar (2005) A Text Book of Plant Anatomy, Campus Books International, New Delhi, India
6. Singh, S. K. and Semma Srivastava (2011) Anatomy of Angiosperm, Campus Books International, New Delhi, India 20. Singh, Sanjay Kumar (2014) Embryology of Angiosperm, Campus Books International, New Delhi, India.

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PAPER- II

BOT.-: 402 PLANT METABOLISM

Lectures 30

AIMS AND OBJECTIVES

1. To know the scope and importance of plant metabolism.
2. To study the properties, mechanism and classification of enzymes.
3. To study the process of photosynthesis in higher plants, C3, C4 and CAM pathways.
4. To study respiration in higher plants.

Unit 1: Introduction **02 L**

1.1: Definition

1.2: Plant cell as organic Laboratory

1.3: Anabolism and catabolism

Unit 2: **Enzymes** **04 L**

2.1: Definition, Structure and properties.

2.2: Classification of enzymes

2.3: Mode of enzyme action: Lock and key Model, Induced fit model

Unit 3: **Photosynthesis** **11 L**

3.1: Definition, photosynthetic apparatus (Structure of Chloroplast)

3.2: Role of photosynthetic pigments: Chlorophyll (Chl- a, Chl- b), Carotenoids and Phycobillins

3.3: Photosystem I and II

3.4: Mechanism

a : Light Reaction: Cyclic and Non Cyclic Photophosphorylation.

b : Dark Reaction: C3, C4 and CAM pathways.

3.6: Photorespiration: Definition, Sites and Mechanism of photorespiration.

3.7: Factor affecting the process of photosynthesis.

Unit 4: Respiration **07 L**

4.1: Introduction, Definition and Types of respiration.

4.2: Mechanism of Aerobic respiration.

a) Glycolysis.

b) Kreb's cycle.

c) Electron Transfer System (ETS)

4.3 Mechanism of Anaerobic respiration: Alcoholic Fermentation

4.4 Factor affecting the process of respiration.

Unit 5: Nitrogen metabolism **06 L**

5.1: Introduction.

5.2: Types of Nitrogen fixation.

5.3: Biological nitrogen fixation.

5.4: Nitrate and ammonia assimilation.

5.5: Importance

REFRENCES:-

1. Kochhar P. L. (1962) Plant Physiology, Atmaram and Sons, Delhi, India
2. Salisbury, F.B and C.W. Ross (1999): Plant Physiology CBS Publishers and Printers, New Delhi
3. Harborne, J.B. (1973). Phytochemical Methods. John Wiley and Sons. New York
4. Mukherjee, S. A.K. Ghosh (1998) Plant Physiology ,Tata McGraw Hill Publishers(P) Ltd., New Delhi
5. Srivastava H. S., 2004. Plant Physiology and Biochemistry, Rastogi Publications.
6. Verma S. K. and Mohit Verma, 2006. A Text book of Plant Physiology, Biochemistry and Biotechnology, S. Chand and Co.
7. . Jain. V.K. (1977) Fundamentals of plant physiology. S. Chand and Company Ltd. New Delhi, India

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PAPER- III

BOT.403: Practical (Based on BOT. - 401 and BOT. - 402)

Practical No.1: Study of the following with the help of P.S. / photographs.

i) T.S. of microsporangium (Anther)

ii) Tapetum – a) Amoeboid b) Secretory

Practical No 2: Study of types of ovules with the help of P.S. / Photographs as per theory.

Practical No 3: Study of different kinds of embryo sac with the help of P.S / Photographs

i) Monosporic - *Polygonum*

ii) Bisporic - *Allium*

iii) Tetrasporic - *Peperomia*

Practical No 4: Mounting of embryos from suitable seeds (*Cucumis / Cymopsis / Citrus*).

Practical No 5: Study of structure of dicot and monocot seed

Practical No 6 and 7: Study of seed dispersal mechanism.

i: Winged – *Moringa, Hiptage*

ii: Parachute – Pappus (*Tridax*)

iii: Hair – *Calatropis*

iv: Floating – Coconut

v: Animal – *Xanthium, Achyranthes*

vi: Sticky – *Plumbago / Cleome / Boerrhaavia*

Practical No 8 and 9: Study the activity of catalase and study the effect of pH and enzyme concentration.

Practical No 10 and 11: To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.

Practical No 12: Comparison of the rate of respiration in any two parts of a plant by using Ganong's potometer.

Practical No 13: Separation of amino acids by paper chromatography.

Practical No 14 and 15: Demonstration experiments

i. To demonstrate the presence of starch in chloroplast

ii. CO_2 essential for Photosynthesis

iii. R.Q. (Respiratory Quotient)

iv. Kuhne's Tube experiment

v . Isolation and Inoculation of *Rhizobium*

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PAPER – IV

SKILL ENHANCEMENT COURSE (SEC)

BOT.404: NURSERY AND GARDENING

Lectures: 30

AIMS AND OBJECTIVES

1. To know the concept of nursery and Gardening.
2. To improve the skills for growing fresh and safe vegetables.
3. To create awareness about home gardening.
4. To develop different skills regarding the gardening operations among the students

Unit 1. Nursery **04 L**

Definition, objectives and scope, building up of infrastructure for nursery, planning and seasonal activities. Planting :direct seedling and transplant.

Unit 2. Seed structures and types **04 L**

Seed dormancy, causes and methods of breaking dormancy, Seed storage: Seed banks, factors affecting seed viability and genetic erosions.

Unit 3. Vegetative propagation **05 L**

Cutting and Air-layering: selection, techniques of cutting, rooting medium, planting and hardening of plants in green house or glass house.

Harvesting, Packing, Storage and Marketing of Nursery stock.

Unit 4. Gardening **07 L**

Definition, objectives and scope,. Different types of gardening: Landscape, home gardening and park, and its Components, suitable plants, soil, manuring and watering.

Unit 5. Indoor Gardening **04 L**

Definition, characters of indoor plants, containers, selection of indoor plants, Potting media, watering tips.

Botanical name, cultivation practices, Ornamental value, maintenance and care of Cycads and Pothas (Two examples each)

Unit 6: Cultivation practices **06 L**

Introduction, study of cultivation of some vegetables: Brinjal and Tomato w.r.t.

i) Sowing ii) Transplanting of seedling

iii) Varieties iv) Mannuaring and irrigation

v) Pest, Diseases and control measures vi) Harvesting

vii) Storage and Marketing

REFERENCES:-

1.Bose T.K. and Mukherjee. D. (1972). Gardening in India, Oxford and IBH Publishing Vo., New Delhi.

2.Sandhu, M. K., (1989), Plant Propagation. Wile Eastern Ltd., Bangalore, Madras.

3.Kumar, N., (1997), Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.

4.Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.

5.Agrawal. P.K. (1993), Hand Book of Seed Technology, Dept. of Agriculture and Cooperations, National Seed Corporation Ltd., New Delhi.

6.Janick Jules. (1979). Horticultural Science. (3rd Ed.) W. H. Freeman and Co., San Francisco. USA.

Equivalence: Theory and Practicals

Class: S. Y. B. Sc.

Subject : Botany

PAPER	Old Courses (W.E.F. June, 2016)	PAPER	New Courses (W.E. F. June, 2019)
SEM-III			
BOT. 231	Bryophytes and Pteridophytes	Bot. 402	Plant Metabolism
BOT. 232	Morphology of Angiosperms	Bot. 401	Plant Embryology
BOT. 233	Based on BOT.231, BOT.- 232,	Bot. 403	Practical (LAB – I) Based on Bot. 401 and Bot. 402
SEM-IV			
BOT. 241	Plant Physiology	Bot. 302	Plant Physiology
BOT. 242	Taxonomy of Angiosperms	Bot. 301	Plant Anatomy
BOT. 243	Based On BOT.-241 and BOT.-242	Bot. 303	Practical (LAB – I) Based on Bot. 301 and Bot. 302

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY

JALGAON 425001, INDIA

SYLLABUS UNDER

FACULTY OF SCIENCE & TECHNOLOGY

UNDER CBCS

FOR COURSES RELATED TO SUBJECT

ZOOLOGY

S.Y.B.Sc. (Semester I and II)

WITH EFFECT FROM

ACADEMIC YEAR 2019-2020

KBC NORTH MAHARSHTRA UNIVERSITY, JALGAON

Syllabus for SYBSc ZOOLOGY under CBCS Pattern

(wef June 2019)

Examination Pattern 60:40

Semester	Core Course	Structure	Code & Title of the paper	Credit
III	DSC 1-C CC A-III	Theory	ZOO 301 Physiology	02
		Theory	ZOO 302 Biochemistry	02
		Practical	ZOO 303 Physiology & Biochemistry	02
	SE Course I	Section I	SEC I Apiculture	02
	AEC III	Section I	English/Marathi Communication (2 periods per week)	02
IV	DSC 1-D CC A-IV	Theory	ZOO 401 Genetics	02
		Theory	ZOO 402 Evolutionary Biology	02
		Practical	ZOO 403 Genetics & Evolutionary Biology	02
	SE Course II	Section II	SEC II Medical Diagnostics	02
	AEC IV	Section II	English/Marathi Communication (2 periods per week)	02
Total Credits Sem III & IV= 16+4=20				

DSC = Discipline selective course
SEC= Skill Enhancement Course
AEC = Ability Enhancement course
Credit 2= 2 hrs/ week = 30 periods per semester

CORE COURSE III

SYBSc Zoology Semester III

ZOO 301 PHYSIOLOGY

THEORY **(CREDITS 2)**

Unit 1: Nerve and muscle (5)
Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 2: Digestion (3)
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit 3: Respiration (5)
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit 4: Excretion (4)
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Unit 5: Cardiovascular system (5)
Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Unit 6: Reproduction and Endocrine Glands (8)
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle, Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

ZOO 302 BIOCHEMISTRY

THEORY **(CREDITS 2)**

Unit 1: Carbohydrate Metabolism (8)
Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Unit 2: Lipid Metabolism (6)
Biosynthesis and β oxidation of palmitic acid, Lipogenesis, Lipolysis

Unit 3: Protein metabolism (8)
Biosynthesis of amino acid, Transamination, Deamination, Decarboxylation and Urea Cycle

Unit 4: Enzymes (8)
Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Factors affecting rate of enzyme mediated reactions, Inhibition and Regulation

ZOO 303 PHYSIOLOGY AND BIOCHEMISTRY

PRACTICAL **(CREDITS 2)**

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
5. Estimation of total protein in given solutions by Lowry's method.
6. Study of activity of salivary amylase under optimum conditions

SUGGESTED READINGS

- 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). T*extbook 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.
- Prakash S.Lohar (2008)Endocrinology:Hormones and Human Health, MJP Publshers , A unit of Tamilnadu Book House, Triplicane, Chennai

Skill Enhancement Course I (Section I)

SEC I

Apiculture

Credit 2

Unit 1: Biology of Bees (4)

History, Classification and Biology of Honey Bees, Social Organization of Bee Colony

Unit 2: **Rearing of Bees** (12)

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture, Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)

Unit 3: **Diseases and Enemies** (5)

Bee Diseases and Enemies Control and Preventive measures

Unit 4: **Bee Economy** (4)

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis, Pollen, etc)

Unit 5: **Entrepreneurship in Apiculture** (5)

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

- Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
- Bisht D.S., Apiculture, ICAR Publication.
- Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi.

CORE COURSE IV

SYBSc Zoology Semester IV

ZOO 401 GENETICS

THEORY **(CREDITS 2)**

Unit 1: Introduction to Genetics (4)

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension (10)

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co dominance, Polygenic inheritance, Multiple alleles, Lethal genes, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping (6)

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, definition of gene mapping.

Unit 4: Mutations (6)

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations

Unit 5: Sex Determination (4)

Chromosomal mechanisms and methods

ZOO 402 EVOLUTIONARY BIOLOGY

THEORY **(CREDITS 2)**

Unit 1: History of Life (2)
Major Events in History of Life

Unit 2: Introduction to Evolutionary Theories (4)
Lamarckism, Darwinism, Neo-Darwinism

Unit 3: Direct Evidences of Evolution (4)
Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Unit 4: Processes of Evolutionary Change (8)
Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 5: Species Concept (4)
Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Unit 6: Macro-evolution (4)
Macro-evolutionary Principles (example: Darwin's Finches)

Unit 7: Extinction (4)
Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

ZOO 403 GENETICS AND EVOLUTIONARY BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Study of Picture/Charts with reference to:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.
- 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.
- Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates

Skill Enhancement Course II (Section II)

SEC II

Medical Diagnostics

THEORY **Credit 2**

Unit 1: **Introduction to Medical Diagnostics and its Importance** (2)

Unit 2: **Diagnostics Methods Used for Analysis of Blood** (10)

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 3: **Diagnostic Methods Used for Urine Analysis** (6)

Urine Analysis: Physical characteristics, normal and abnormal constituents

Unit 4:**Non-infectious Diseases** (6)

Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/ diagnostic kit

Unit 5: **Infectious Diseases** (3)

Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit 6: **Tumours** **(**3)

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

SUGGESTED READINGS

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology
- Edition, Bhalani Publishing House Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- Robbins and Cortan, Pathologic Basis of Disease, VIIIEdition, Saunders
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

(NAAC Re-Accredited)

SYLLABUS FOR CORE AND SKILL ENHANCEMENT COUESES IN BOTANY

As Per U. G. C. Guidelines

Based on

Choice Based Credit System (CBCS)

T. Y. B. Sc. BOTANY SEMESTER - WISE SYLLABUS

(Theory and Practicals)

To Be Implemented From

Academic Year 2020 - 2021

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

SYLLABUS FOR CORE AND SKILL ENHANCEMENT COUESES IN BOTANY

As Per U. G. C. Guidelines

Based on

Choice Based Credit System (CBCS)

T. Y. B. Sc. BOTANY SEMESTER - WISE SYLLABUS

(Theory and Practicals)

SEMESTER - V

DISCIPLINE SPECIFIC COURSES

Bot. 501: Lower Cryptogams

Bot. 502: Morphology and Systematics of Angiosperms

Bot. 503: Cell biology and Genetics

Bot. 504: Plant Physiology and Biochemistry

SKILL ENHANCEMENT COURSE

Bot. 505: Biofertilizers

ELECTIVE COURSES

Bot. 506A: Analytical Techniques in Plant Sciences

Bot. 506B: Horticulture

PRACTICAL COURSES

Bot. 507: Practical - I: Based on BOT. 501 & BOT. 505

Bot. 508: Practical - II: Based on BOT. 502 & BOT. 506 A & BOT. 506B

Bot. 509: Practical - III: Based on BOT. 503 & BOT. 504

W. E. F. JUNE, 2020

SEMESTER - V

Discipline	Core Course Type	Course Code	Course Title	Credits	Total Hrs./ Week	Total Teaching Hrs.	Total Mark (100)	
							CA	UA
Discipline Specific Course (DSC)	Paper - I	BOT.501	Lower Cryptogams	3	3	45	40	60
	Paper - II	BOT.502	Morphology and Systematics of Angiosperms	3	3	45	40	60
	Paper -III	BOT.503	Cell Biology and Genetics	3	3	45	40	60
	Paper -IV	BOT.504	Plant Physiology and Biochemistry	3	3	45	40	60
DSC Skill Enhancement Course	Paper - V	BOT.505	Biofertilizer	3	3	45	40	60
DSC Elective Course (Any one)	Paper -VI	BOT.506 A	Analytical Techniques in Plant Sciences	3	3	45	40	60
		BOT.506 B	Horticulture	3	3	45	40	60
DSC Core Practicals	Practical I	BOT.507	Practicals Based on BOT.501 and BOT.505	4	4/Batch	60	40	60
	Practical II	BOT.508	Practicals Based on BOT.502 and BOT.506A or Bot.506B	4	4/Batch	60	40	60
	Practical III	BOT.509	Practicals Based on BOT.503 and BOT.504	4	4/Batch	60	40	60
Non-Credit Audit Course (Any One)	Paper-VII	AC-510	NSS	No Credit	2	30	100	--
		AC-511	NCC					
		AC-512	Sports					

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Equivalence of the T. Y. B. Sc. Botany CBCS Syllabus

Paper	Course	SEMESTER - V CBCS Syllabus (New)	Course	SEMESTER - V CGPA Syllabus (Old)
I	Bot. 501	Lower Cryptogams	Bot. 351	Cryptogams
II	Bot. 502	Morphology and Systematics of Angiosperms	Bot. 352	Angiosperm Taxonomy
III	Bot. 503	Cell biology and Genetics	Bot. 353	Cell and Molecular Biology
IV	Bot. 504	Plant Physiology and Biochemistry	Bot. 354	Advanced Plant Physiology
V	Bot. 505	Biofertilizers	Bot. 355	Plant Ecology and Phytogeography
VI	Bot.506A/ Bot.506B	Analytical Techniques in Plant Sciences/ Horticulture	Bot.356.1/ Bot.356.2/ Bot.356.3/ Bot.356.4	Plant Biotechnology/ Ethnobotany/ Gardening/Seed Technology and seed pathology

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus of T. Y. B. Sc. Botany w. e. f. June, 2020

CBCS Pattern

DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - V

PAPER - I

BOT. 501: LOWER CRYPTOGAMS (Lectures: 45)

AIMS AND OBJECTIVES:

1. To study salient features of cryptogamic plants.
2. To make students aware about the status of cryptogams as a group in plant kingdom.
3. To study the life cycles of selected genera.
4. To study economic and ecological importance of cryptogramic plants.

Unit 1: An introduction to Algae **(09 Lectures)**

1.1. Definition and general characters
1.2. Habit and habitat
1.3. Organization of thallus
1.4. Similarities, differences with fungi and Bryophytes
1.5. Reproduction
1.6. Life cycle patterns: Haplontic, Diplontic and Diplohaplontic
1.7. Outline classification of Algae according to F. E. Fritsch (1945) up to classes with suitable examples

Unit 2: Study of Life cycle with emphasis on systematic position, occurrence, morphology, reproduction and alternation of generation of ***Chara*** and ***Sargassum*** **(09 Lectures)**

Unit 3: An introduction to fungi **(09 Lectures)**

3.1. Definition and General Characters
3.2. Habit and habitat
3.3. Structure of thallus
3.4. Reproduction
3.5. Outline classification of fungi according to Ainsworth (1973) up to classes with suitable examples.

Unit 4: Study of Life cycle of fungi with reference to systematic position, thallus structure, reproduction of *Albugo* and *Uncinula* **(09 Lectures)**

Unit 5: Applied Phycology and Mycology **(09 Lectures)**

5.1. Role of Algae in i) Agriculture ii) Industry iii) Biotechnology iv) Water Pollution
5.2. Role of Fungi in i) Agriculture ii) Industry iii) Food iv) Medicine
5.3. Contribution of following Phycologists
i) Prof. M. O. P. Iyengar ii) Prof. T. V. Deshikachary
5.4. Contribution of following mycologists

i) Prof. E. J. Buttler ii) Prof. C. V. Subramanian

REFERENCE BOOKS

1. Alexopoulus C. J, Mims C.W. and Blacwel M. I. (1996). Introductory Mycology. John Wiley and Sons Inc. New York, U.S.A.
2. Bold, H. C. and M. J. M. Wynne (1978). Introduction to the Algae - Structure and Reproduction. Prentice Hall of India Pvt. Ltd. New Delhi.
3. Chapman, V. J. and D. J. Chapman (1979). The Algae. English Language Book Soc. & Mac Millons, London.
4. Dube, H. C. (1990). An Introduction to Fungi. Vikas Pub. House Ltd. New Delhi, India.
5. Ganguli, H. C. and Kar, A. K. (2001). College Botany Vol. I. Books and Allied Press Ltd. Kolkata, India
6. Kumar H. D. (1988). Introductory Phycology. Affiliated East West Press Ltd. New Delhi
7. Kumar H. D. and H. N. Singh (1976). A Text Book of Algae. Affiliated East West Press Ltd. New Delhi, India
8. Pandey, B. P. (1994). A Text Book of Botany - Algae. S. Chand & Co. Ltd. New Delhi, India.
9. Pandey, S. N., Trivedi, P. S. and S. P. Misra (1995). A Text Book of Algae. Vikas Pub. House Pvt. Ltd. New Delhi, India.
10. Prescott, G. W. (1969). The Algae: A Review. Thomas Nelson and Press, London, U.K.
11. Sharma, O. P. (1990). Text Book of Algae. Tata McGraw Hill Pub. Co. Ltd. New Delhi, India.
12. Sharma, O. P. (1990). Text Book of Fungi. Tata McGraw Hill Pub. Co. Ltd, New Delhi, India.
13. Singh, Pande and Jain. (2004). Text book of Botany. Diversity of Microbes and Cryptogams. Rastogi Publications, Gangotri, Shivaji Road, Meerut
14. Smith G. M. (1955). Cryptogamic Botany Vol. I: Algae and Fungi. McGraw Hill Book Co. New York, U.S.A.
15. Vashishta, B. R. (2012). Botany for Degree Students - Algae. S. Chand & Co. Ltd. New Delhi, India.

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DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - V

PAPER - II

BOT. 502: MORPHOLOGY AND SYSTEMATICS OF ANGIOSPERMS (Lectures: 45)

AIMS AND OBJECTIVES:

1. To study vegetative and floral morphology of angiospermic plants
2. To study the status of angiosperm in plant kingdom
3. To study the origin of angiosperm with respect to age and probable ancestors
4. To study various angiosperm families emphasizing their morphology, salient features etc.
5. To know the role of anatomy and embryology in taxonomy

Unit1. Vegetative Morphology **(09 Lectures)**

1.1. Definition and scope of Morphology

1.2. Root: Definition, General characters and functions

Types of root: Tap and Adventitious

1.3. Stem: Definition, General characters and functions

1.4. Leaf: Definition,

a) Parts of typical leaf.

b) Types of leaf: Simple, Compound: Pinnately and Palmately.

c) Phyllotaxy: Alternate, Opposite and whorled.

d) Venation: Reticulate and parallel

1.5. Leaf Modifications: Phyllode, Pitcher

Unit 2: Floral Morphology **(09 Lectures)**

2.1. Inflorescence: Definition, Parts of Inflorescence

Types of Inflorescence:

a) Racemose - Raceme, Spike, Catkin, Spadix, Corymb, Umbel and Capitulum

b) Cymose: Solitary, Uniparous, Biparous and Multiparous cyme

c) Special Types: Cyathium, Verticillaster, Hypanthodium

2.2. Flower: Definition, Parts of typical flower and their functions

2.3. a) Insertion of floral leaves on thalamus: Hypogynous, Perigynous and Epigynous

b) Symmetry: Actinomorphic, Zygomorphic and Asymmetric

2.4. Calyx: Polysepalous, Gamosepalous

2.5. Corolla:

a) Regular polypetalous - Cruciform, Caryophyllaceous and Rosaceous

b) Irregular polypetalous - Papilionaceous,

c) Regular gamopetalous: Campanulate, Tubular, Infundibuliform, Rotate and Hypocrateriform

d) Irregular gamopetalous: Bilabiate, Ligulate and Personate

2.5. Androecium:

i) Cohesion of Stamen:

a) Adelphy: Monadelphous, Diadelphous, Polyadelphous

b) Syngeny

c) Synandry

ii) Adhesion of stamen: Episepalous, Epipetalous, Epiphyllous and Gynandrous

2.6. Gynoecium: Apocarpous and Syncarpous pistil, Monocarpellary, Bicarpellary and polycarpellary

Types of Placentation: Marginal, Basal, Axile, Parietal, Free central and superficial

2.7. Fruit: Definition, Parts of typical fruit

Types: a) Simple - Loculicidal capsule

b) Aggregate - Etaerio of berries

c) Composite - Syconus

Unit 3: Study the origin of Angiosperms **(09 Lectures)**

3.1. Definition, Distinguishing Characters of Angiosperms

3.2. Taxonomy : Aims of taxonomy - Empirical and Interpretative approach

3.4. The origin of Angiosperms: w. r. t.

i) Age of Angiosperms

ii) Probable ancestors of angiosperms:

a) The Anthostrobilus (Bennettitalean) theory

b) The Gnetales theory

Unit 4: Systems of Classification and Modern Trends in Taxonomy **(09Lectures)**

4.1. Study of Systems of Classification w. r. t. outline, merits and demerits of Hutchinson's system and Engler and Prantl's system

4.2. Modern Trends in Taxonomy

Role of following with suitable examples:

a) Anatomy

b) Embryology

Unit 5: Study of Angiosperm Families **(09 Lectures)**

(*Sensu* Bentham and Hooker's system of classification)

Study of following families w. r. t. geographical distribution, systematic position, morphological characters (vegetative and floral), salient features, floral formula and economic importance of the following families.

1. Annonaceae
2. Rutaceae
3. Caesalpiniaceae
4. Compositae (Asteraceae)
5. Sapotaceae
6. Asclepiadaceae
7. Amaranthaceae

8. Liliaceae

   Point of biological interest of Asclepiadaceae

REFERENCE BOOKS

1. Ganguly, H. C. and Das, K. S. (1986). College Botany Vol.I (6th Edition). New Central Book Agency, Calcutta, India.
2. Ganguly, H. C., Dasand, K. S. and Datta, C. T. (1968). College Botany Vol. I. New Central Book Agency, Calcutta, India.
3. Heywood, V. H. and Moore, D. M. (Eds.) (1984). Current Concepts in Plant Taxonomy. Academic Press, London, U.K.
4. Jeffrey, C. E. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge, London, U.K.
5. Kumar, N. C. (1995). An Introduction to Taxonomy of Angiosperms. Himalaya Publishing House, Nagpur, India.
6. Lawrence, G. H. M. (1951). Taxonomy of Vascular Plants. McMillan, New York, U.S.A.
7. Mondal, A. K. (2005). Advanced Plant Taxonomy. New Central Book Agency (P) Ltd. Kolkata, India.
8. Naik, V. N. (1985). Taxonomy of Angiosperms. Tata McGraw Hill Publ. Co. Ltd. New Delhi, India.
9. Pandey, B. P. (1997). A Text Book of Angiosperms. S. Chand & Company Ltd., New Delhi.
10. Sharma, O.P. (1993). Plant Taxonomy. Tata McGraw Hill. Publ. Co. Ltd. New Delhi, India.
11. Singh, V. (1993). Taxonomy of Angiosperms. Rastogi Publication, Meerut (U.P.) India.
12. Singh, V., Pande, P. C. and Jain, D. K. (2013). A Text Book of Botany: Angiosperms. Rastogi Publications, Meerut (U. P.), India.
13. Singh, M. P., Nayar, M. P. and Roy, R. P. (1994). Text Book of Forest Taxonomy. Anmol Publ. P. (Ltd.) New Delhi, India.
14. Subramanayam, N. S. (1997). Modern Plant Taxonomy. Vikas Publ. House, New Delhi, India.
15. Sivarajan, V. V. (1984). Introduction to Principles of Plant Taxonomy. Oxford & I. B. H. Publishing Co. New Delhi, India.
16. Vashistha, P. C. (1992). Taxonomy of Angiosperms. S. Chand & Co. Publishers, New Delhi, India.

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DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - V

PAPER - III

BOT. 503: CELL BIOLOGY AND GENETICS **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To study the Prokaryotic and eukaryotic cell
2. To study the cell components and their functions
3. To study the cell cycle
4. To introduce the students with “Science of Heredity”
5. To study linkage and crossing over

Unit 1: Cell and Cell Cycle **(09 Lectures)**

1.1. Introduction, definition and history of cell, types of cell, Characteristics of Prokaryotic and eukaryotic cells, Cell theory

1.2. Cell Wall and Cell Membrane: Definition, Physical and chemical Properties and functions of plant cell wall and Membranes Unit Membrane model, Fluid Mosaic model

1.3. Various phases of Eukaryotic cell cycle, Mitosis and Meiosis

Unit 2: Cell organelles **(09 Lectures)**

2.1. Mitochondria: Ultra Structural organization and function of Mitochondria

2.2. Chloroplast: Ultra Structural organization and function of Chloroplast

2.3. Endoplasmic reticulum: Ultra Structure, types and functions

2.4. Golgi Complex: Ultra Structure and function

2.5. Nucleus: Structure, Morphology and Ultra structure (Nuclear envelope, Nucleoplasm, Chromatin material and Nucleolus)

2.6. Chromosome: Morphology, Types of chromosomes on the basis of centromere

Genetics

Unit 3: Introduction **(09 Lectures)**

3.1. Genetics: Introduction, History and scope

3.2. Mendelian Genetics: Mendelism, History, Terminology, Mendel’s laws, Monohybrid, Dihybrid cross.

3.3. Gene interaction: Lethal gene, Complementary gene, Duplicate and Dominant epistatic.

3.4. Cytoplasmic inheritance: Definition, chloroplast inheritance in variegated 4o clock plant (*Mirabilis jalapa*). Cytoplasmic male sterility in maize.

3.5. Multiple alleles: Definition, characters and examples (*Nicotiana* sps.).

Unit 4: Linkage and Crossing over **(09 Lectures)**

4.1. Introduction: Concept and history of linkage, Kinds of Linkages, Hypothesis of Linkages (Bateson and Punnett)

4.2. Crossing over: Introduction, Definition, Mechanism and types (Single and Double)

Unit 5: Chromosomal aberrations **(09 Lectures)**

5.1. Introduction, Definition.

5.2. Types of Chromosomal Aberrations

5.3. Numerical change: Euploidy, aneuploidy and its types

5.4. Structural changes: Addition, deletion, substitution, translocation and inversion

REFERENCE BOOKS

1. Gardner, E. J., Simmons, M. J. and Snustad, D. P. (2008). Principles of Genetics, 8^{th} Ed. John Wiley and Sons, New Jersey, U.S.A.
2. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics, 5^{th} Ed. John Wiley and Sons, New Jersey, U.S.A.
3. Klug, W. S., Cummings M. R., Spencer C. A., Palladino, M. A. (2011). Concepts of Genetics, 10^{th} Ed. Benjamin Cummings Publishing, San Francisco, California, U.S.A.
4. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis, 10^{th} Ed. W. H. Freeman and Co., U.S.A.
5. Pierce, B. A. (2011). Genetics: A Conceptual Approach, 4^{th} Ed. Macmillan Higher Education Learning.
6. Karp, G. (2010). Cell Biology, 6^{th} Ed. John Wiley & Sons, New Jersey, U.S.A.
7. Hardin, J., Becker, G., Kleinsmith, L. J. (2012). Becker's World of the Cell, 8^{th} Ed. Pearson Education Inc. U.S.A.
8. Cooper, G. M. and Hausman, R. E. (2009). The Cell: A Molecular Approach, 5^{th} Ed. ASM Press; Sunderland, Washington, D. C., Sinauer Associates, MA.
9. Becker, W.M., Kleinsmith, L. J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell, 7^{th} Ed. Pearson Benjamin Cummings Publishing, San Francisco California, U.S.A.

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DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - V

PAPER - IV

BOT. 504: PLANT PHYSIOLOGY AND BIOCHEMISTRY **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To study the growth pattern of plant
2. To know the phenomenon of photoperiodism and effect of phytochrome on flowering
3. To study the vernalization process
4. To know the path of translocation
5. To study the biomolecules in plants
6. To study secondary metabolites and their role in plants

Plant Physiology

Unit 1: Plant growth and Movement **(09 Lectures)**

1.1. Plant growth: Introduction and Definition
1.2. Phases of growth
1.3. Growth curve
1.4. Factors affecting growth
1.5. Plant movement: Introduction and Definition
1.6. Types of plant movement: i) Tropic ii) Tactic iii) Nastic

Unit 2: Physiology of flowering **(09 Lectures)**

2.1. Photoperiodism:
  a) Introduction, Definition
  b) Classification of plants: SDP, LDP, DNP
  c) Photoperiodic induction
  d) Phytochrome and role of phytochrome in flowering

2.2.Vernalisation:
  a) Introduction and Definition
  b) Mechanism of vernalization, hypothesis of phasic development and hypothesis of hormonal involvement
  c) Devernalization

Unit 3: Translocation of organic solutes **(09 Lectures)**

3.1. Definition
3.2. Path of translocation
3.3. Evidences for phloem transport
3.4. Mechanism of translocation: Pressure flow theory, Diffusion
3.5. Source to sink relationship
3.5. Phloem loading and unloading
3.6. Factors affecting phloem translocation i) External: temperature, light ii) Internal: Hormonal and metabolic inhibition

Biochemistry

Unit 4: Biomolecules **(09 Lectures)**

4.1. Introduction

4.2. Carbohydrates: Introduction, definition, classification, properties and functions of carbohydrates

4.3. Amino acids and proteins: Introduction, definition, properties of amino acids. Role of amino acids in plants. Classification of proteins (Primary and secondary proteins), properties and functions of proteins

4.4. Lipids: Introduction, definition, classification, properties and functions of lipids

Unit 5: Secondary Metabolites **(09 Lectures)**

5.1. Introduction, Definition

5.2. Distribution of Secondary metabolites

5.2. Brief account of sec. metabolites w. r. t. occurrence in plants, and function of a) alkaloids, b) flavonoids c) Terpenes.

5.6. Role of Secondary metabolites in plants

REFERENCE BOOKS

1. Bidwell, R. G. S. (1974). Plant Physiology. Macmillan Publishing Co. Third Avenue, New York.
2. Buchanan B. B., Gruissem, W. and Jones, R. L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, U.S.A.
3. Dennis, D. T., Turpin, D. H., Lefebvre D. D. and Layzell D. B. (eds) (1997). Plant Metabolism, 2nd Ed. Longman, Essex, England.
4. Galstone, A. W. (1989). Life processes in Plants. Scientific American Library, Springer Verlag, New York, U.S.A.
5. Leninger, A. C. (1987). Principles of Biochemistry. CBS Publishers and Distributers (Indian Reprint)
6. Lincoln, Taiz and Eduardo, Zeiger (2003). Plant Physiology, 3rd Ed. Published by Panima Publishing Corporation
7. Moore, T. C. (1989). Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York, U.S.A.
8. Singhal, G. S., Renger, G., Sopory, S. K., Irrgang, K. D. and Govindjee (1999). Concept in Photobiology, Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi, India.
9. Pandey, S. N. and Sinha, B. K. (2014). Plant Physiology. Vikas Publishing House Pvt. Ltd. India.
10. Salisbury, F. B. and Ross, C. W. (1992). Plant physiology, 4th Ed. Wadsworth Publishing Company, California, U.S.A.
11. Taiz, L. and Zeiger, E. (1998). Plant Physiology, 2nd Ed. Sinauer Associates, Inc. Publishes, Massachusetts, USA.

12. William, G. Hopkins (1995). Introduction to Plant Physiology. John Wiley and Sons, New Jersey, U.S.A.
13. Verma, S. K. and Verma, Mohit (2007). A Textbook of Plant Physiology Biochemistry and Biotechnology. S. Chand & Co. Ltd. New Delhi, India.

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DSC SKILL ENHANCEMENT COURSE

SEMESTER - V

PAPER - V

BOT. 505: BIOFERTILIZERS **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To introduce application of Biofertilizer technology in Agriculture
2. To familiarize students with microbes used as biofertilizers
3. To demonstrate the low cost media preparation and cultural practices in biofertilizers
4. To aware the students about benefits of applications of biofertilizers
5. To create self employment opportunities among the students

Unit 1: Introduction **(09 Lectures)**

1.1. Introduction, Scope and importance of Biofertilizers

1.2. General account of the microbes used as Biofertilizers

1.3. Isolation of *Rhizobium*, Identification, Mass multiplication, Carrier based inoculants

Unit 2: Bacterial Biofertilizers **(09 Lectures)**

2.1. *Azospirillum* isolation and mass multiplication, carrier based inoculants and associative effect of different organisms

2.2. *Azotobacter*, classification and characteristics

2.3. Crop response to *Azotobacter* inoculums, Mass multiplication of *Azotobacter*

2.4. Applications of *Azospirillum*

Unit 3: Algal Biofertilizers **(09 Lectures)**

3:1. Cyanobacteria (Blue Green Algae): Isolation of *Anabaena* from *Azolla*, Mass Multiplication of *Anabaena*

3.2. *Azolla* - *Anabaena* relationship

3.3. Biological Nitrogen fixation

3.4. Blue Green algae in a rice cultivation.

3.5. Applications of BGA

Unit 4: Fungal Biofertilizers **(09 Lectures)**

4.1. Introduction, Occurrence and Distribution of Mycorrhizal association.

4:2. Types of Mycorrhizal association, growth and yield - colonization of VAM - Vesicular Arbuscular Mycorrhiza

4.3. Mycorrhizal applications in agriculture

Unit 5: Compost and Manure **(09 Lectures)**

5.1. Organic Farming, green manuring, organic manures and their uses

5.2. Recycling by composting method of biodegradable, municipal, agricultural and industrial wastes

5.3. Biocompost making methods, Types and methods of vermicomposting

5.4. Benefits of vermicompost, field applications

REFERENCE BOOKS

1. Dubey, R. C. (2005). A text book of Biotechnology. S. Chand & Co. New Delhi, India.
2. Kumaresan, V. (2005). Biotechnology. Saras Publication, New Delhi, India.
3. Sathe, T. V. (2004). Vermiculture and Organic Farming. Daya Publishers, Delhi, India.
4. Jshon, Jothi Prakash, E. (2004). Outline of Plant Biotechnology. Emkay Publication, New Delhi, India.
5. Subha Rao, N. S. (2000). Soil Microbiology. Oxford and IBH Publishers, New Delhi, India.
6. Vayas, S. C., Vayas S. and Modi, H. (1990). Biofertilizers and Organic Farming. Ekta Publication, Nanded, India.

Webliography

1. Production of various Biofertilizers.www.biology discussion.com
2. Biofertilizers vikaspedia.in
3. www.solverchem.com

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DSC ELECTIVE COURSE

SEMESTER - V

PAPER - VI

BOT. 506 A: ANALYTICAL TECHNIQUES IN PLANT SCIENCES (Lectures: 45)

AIMS AND OBJECTIVES:

1. To study Imaging technique for the study of plants
2. To study micrometry and calibration of microscope.
3. To study techniques of slide preparation and staining.
4. To know the principle and working of Instruments.
5. To study chromatography techniques
6. To study statistical analysis methods.

Unit 1: Microscopy **(09 Lectures)**

1.1. Introduction,

1.2. Principles of microscopy; Image quality, Magnification concept, Choice of eye piece and objective combinations to ensure optimal magnification, magnification power,

1.3. Resolution - phenomenon, resolving power of microscope, contrast and resolution of images

1.4. Light microscopy; Fluorescence microscopy

1.5. Brief account of Transmission and Scanning electron microscopy

Unit 2: Micrometry and Micro technique **(09 Lectures)**

2.1. Introduction,

2.2. Principle, micrometer types, Eye piece Reticle/inserts, stage micrometer

2.3. Calibration of ocular scale and microscope

2.4. Micro technique: Introduction, preparations for microscopic observation - WM, smears, squashes, sections, Materials - cover glass, micro slides

2.5. Stains: nature and use of Haematoxyline, Cotton blue, Light Green, Safranin, Sectioning - Free hand

Unit 3: Biophysicochemical techniques **(09 Lectures)**

3.1. Centrifugation: Principle of Centrifugation; types centrifuge and applications.

3.2. Spectrophotometry**:** Introduction, types, Principle and its application in biological research

Unit4: Chromatography **(09Lectures)**

4.1 Principle

4.2 Paper chromatography

4.3 TL chromatography

4.4. HPLC

Unit 5: Biostatistics **(09 Lectures)**

5.1. Introduction to Statistics
5.2. Sampling Methods: Random, Systematic
5.3. Representation of Data: Tabular, Graphical
5.4. Measures of central tendency, Arithmetic mean, mode, median
5.5. Measures of dispersion: Range, mean deviation
5.6. Standard deviation
5.7. Chi square test

REFERENCE BOOKS

1. Plummer, D. T. (1996). An Introduction to Practical Biochemistry, 3rd Ed. Tata McGraw Hill Publishing Co. Ltd. New Delhi, India.
2. Ruzin, S. E. (1999). Plant Micro technique 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, 3rd Ed. John Wiley and Sons, New Jersey, U.S.A.
4. Zar, J. H. (2012). Biostatistical Analysis, 4th Ed. Pearson Publication, U.S.A.
5. Banerjee, Pranab Kumar (2007). Introduction to biostatistics. S. Chand & Co. New Delhi, India.
6. Irfan A. Khan and Khan, Irfan A. (1994). Fundamentals of biostatistics. Ukaaz Publications, Hyderabad, India.
7. Mahajan, B. K. (1989). Methods in Biostatistics for medical students and research workers. Jaypee Brothers Medical Publishers (P) Ltd. Mumbai, India.
8. Parikh, M. N. and Gogtay, Nithya (2009). ABC of Research Methodology and Applied Biostatistics. Jaypee Brothers Medical Publishers (P) Ltd. New Delhi, India.
9. Rao, K. Visweswara (2010). Biostatistics in brief: Made Easy. Jaypee Brothers Medical Publishers (P) Ltd. New Delhi, India.
10. Purohit, S. G., Ranade, V. D. and Dusane, A. V. (2002). Introduction to Biometry. Narendra Prakashan, Pune, India.
11. Daniel, Wayne W. (2010). Biostatistics: Basic Concepts and Methodology for the Health Sciences. John Wiley & Sons, New Jersey, U.S.A.
12. Agarwal, B. L. (2009). Basic statistics. New Age International(P) Ltd. New Delhi, India.
13. Antonisamy, B., Christopher, Solomon and Samuel P. Prasanna (2010). Biostatistics: Principles and Practice. Tata McGraw Hill Pub. Co. Ltd. New Delhi, India.
14. Rao, Sundar P. S. S., Richard, J. (2006). Introduction to biostatistics and research methods. PHI Learning Pvt. Ltd. New Delhi, India.
15. Laware, Shankar And Shinde, Bajirao (2012). Drought stress in peanut. LAP Lambert Academic Publishing, Saarbrucken, Germany.

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DSC ELECTIVE COURSE

SEMESTER - V

Paper - VI

BOT. 506B: HORTICULTURE **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To know horticulture, its scope, disciplines and importance
2. To understand different horticultural practices and their methods
3. To study importance, principles and types of Bahar treatment
4. To study role played by green and poly houses in horticulture
5. To understand methods of preservations and preparations of preserved products prevailing especially in this part of the state

Unit: 1 Introduction **(04 Lectures)**

1.1. Definition, Scope and importance of Horticulture

1.2. Disciplines of Horticulture

i) Pomology ii) Olericulture iii) Floriculture

iv) Ornamental horticulture v) Landscape horticulture

1.3. Nutritive value of Fruits and Vegetables

Unit2: Propagation of Horticultural plants **(10 Lectures)**

2.1. Sexual Propagation: Advantages and Disadvantages

2.2. Asexual /Vegetative Propagation: Advantages and Disadvantages

2.3. Natural methods of vegetative propagation:

Bulb, Corm, Tuber, Rhizome, Runner, Offset, Sucker

2.4. Artificial methods of vegetative propagation

A) Cutting:

a) Definition

b) Types of Cutting:

i) Stem cutting - Soft wood cutting and Hard wood Cutting

ii) Leaf Cutting

iii) Root Cutting

B) Layering:

a) Definition

b) Types of Layering:

i) Simple layering

ii) Compound layering

iii) Air layering/Gootee

C) Budding:

a) Definition

b) Types of Budding - i) Shield/T - Budding ii) Patch Budding

D) Grafting:

a) Definition

b) Types of Grafting - i) Whip grafting ii) Tongue grafting

Unit3: Special Horticultural Practices **(12 Lectures)**

3.1. Training and pruning of Plants:
a) Definition
b) Objectives of Training and Pruning
c) Advantages of Training and Pruning
d) Difference between Training and Pruning
e) Methods of Training: i) Central leader system ii) Open centre system
iii) Modified leaders
f) Methods of Pruning: i) Heading back ii) Thinning out

3.2. Bahar Treatment:
a) Definition, Principles and Importance
b) Types of Bahar: i) Ambe Bahar ii) Mrig Bahar
iii) Hasta Bahar

3.3. Cultural practices:
a) Definition
b) Types of cultural practices: i) Ringing ii) Girdling
iii) Notching iv) Bending

Unit 4: A) Fruits (Grapes) and vegetables (Tomato) production technology **(09 Lectures)**

i) Introduction
ii) Soil and climate requirement
iii) Commercial varieties
iv) Pest and disease management
v) Harvesting and post harvest management

B) Polyhouse, Green house and Glass house technology with reference to Ornamental Horticulture, Scope and importance

Unit5: Preservation of Fruits and Vegetables **(10 Lectures)**

5.1. Introduction, scope and importance of fruits and vegetables preservation

5.2. Methods of preservation:
a) Temporary preservation:
i) Asepsis ii) Exclusion of moisture
i. e. Drying of vegetables e. g. Potato, Cabbage, Onions, Bitter Gourd, Green Pea, Spinach
iii) Use of mild antiseptic iv) Pasteurization
v) Low temperature

b) Permanent preservation:
i) Sterilization and Processing: Use of sugar, salts, vinegar or preservation by food additives i. e. Chemical preservatives: citric acid. Potassium meta-bisulphite, sodium benzoate, Sulphur-dioxide
ii) Drying, Dehydration and concentration of fruits and vegetables
iii) Ionizing radiation

5.3. Preparation of preserved products:
a) Mix fruit Jam

b) Wood apple/Guava Jelly
c) Lemon/ Orange Squash
d) Tomato ketchup

REFERENCE BOOKS

1. Azad, K. C. and Sharma, V. K. (2000). Horticulture Technology (Vol. I&II). Deep and Deep Publications, New Delhi, India.
2. Bal, J. S. (1997). Fruit growing. Kalyani Publication, New Delhi, India.
3. Bose, T. (1996). Fruit tropical and Sub tropical. Naya Pracation , Calcutta, India.
4. Edmond, J. B., Senn, T. L., Andrew, F. S. and Halfacr, R. G. (1990). Fundamentals of Horticulture. Tata McGraw Hill Publishing Co. Ltd. New Delhi, India.
5. Girdhari Lal., Siddhappa, G. S. and Tandon, G. L. (1998). Preservation of fruits and vegetables. ICAR New Delhi, India.
6. Hartmann, H. T. and Kester, D. E. (1989). Plant propagation principles and practice. Prentice Hall of India (P) Ltd. New Delhi, India.
7. Khan, M. R. (1995). Horticulture and Gardening. Nirali Prakashan, Pune, India.
8. Sen, S. (1992). Economic Botany. New Central Book Agency, Calcutta, India.
9. Sharma, N. K. and Arora, S. K. (1985). New Routes to increase Brinjal production. Fmr. Parlim 20 (6) 11 - 12.
10. Sharma,V. K. (2004). Advances in Horticulture. Deep and Deep Publications, New Delhi, India.
11. Sharma, V. K. (1999). Encyclopedia of Practical Horticulture.
12. Singh, V. B. (1990). Fruits of NE Region. Wiley Eastern Limited, New Delhi, India.
13. Sonane, H. N., Deore, B. P. and Patil, S. K. (1984). Vaishali (RHR 51) A High yielding Variety of Brinjal for Maharashtra. Journal of Maharashtra Agriculture Uni. 9(3):341-342
14. Vishnu Swarup (1997). Ornamental horticulture. Macmillan Ltd. New Delhi, India.
15. Reddy, Mallikarjun and Rao, Aparna (2010). Applied Horticulture. Pacific Book International, Delhi, India.
16. Sharaf, Sandhya (2012). Green House Management of Horticulture Crops. Oxford book Co. New Delhi, India.
17. Sharon Pastor Simson, Martha C. Straus (2010). Basics of Horticulture. Oxford Book Co. New Delhi, India.
18. George, Acquaah (2008). Horticulture: Principles and Practices, 4^{th} Ed. PHI Learning private Ltd. New Delhi, India.

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SEMESTER - V

PRACTICAL COURSES

PRACTICAL PAPER - I

BOT. 507: Based on Theory Paper - I & V

(BOT. 501 and BOT. 505)

Practicals Based on Bot. 501: Lower cryptogams

Practical - 1 & 2: Study of range of thallus structure in algae with the help of materials or Permanent slides (any one from the examples):

a) Unicellular thallus: *Chlamydomonas*, *Chlorella*

b) Colonial thallus: *Pandorina*, *Eudorina*, *Volvox*, *Hydrodictyon*

c) Filamentous thallus: *Pithophora*, *Chaetophora*, *Coleochaetae*, *Stigeoclonium*, *Drapanaldia*, *Fritscheilla* and *Oedogonium*

d) Siphonaceousthallus: *Vaucheria*, *Caulerpa*

e) Pseudoparenchymatous: (Uniaxial/Multiaxial) thallus: *Batrachospermum*, *Polysiphonia*

f) Parenchymatousthallus: *Ulva*, *Enteromorpha*

Practical - 3: Study of life cycle of ***Chara***

Practical - 4: Study of life cycle of ***Sargassum***

Practical - 5: Study of fungal forms (any four)

i) *Stemonitis* ii) *Saprolegnia* iii) *Rhizopus*

iv) *Eurotium* v) *Puccinia* vi) *Alternaria*

Practical - 6: Study of life cycle of ***Albugo***

Practical - 7: Study of life cycle of ***Uncinula***

Practical - 8: Culture of Algae (Venkatraman method)/Culture of Fungi on PDA medium

NOTE: Study tour is compulsory. Students are expected to submit two forms of Algae and Fungi each. Photographs of any two forms Algae and Fungi along with tour report.

Practicals Based on Bot. 505: Biofertilizers

Practical - 9: Diversity of BGA with the help of locally available specimens - *Nostoc*, *Anabaena*, *Oscillatoria*, *Gloecapsa* (Any three)

Practical - 10: Preparation of Yeast Extract Mannitol Agar Medium (YEMA Medium)

Practical - 11 and 12: *Rhizobium* culture with the help of healthy leguminous root nodules.

Practical- 13: Mass culture of BGA (Venkatraman method)

Practical - 14: Preparation of Compost, FarmYard Manure (FYM).

Practical - 15: Study of Ectomycorrhiza and Endomycorrhiza with the help of PS/ Photograph.

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PRACTICAL PAPER - II

BOT. 508: Based on Theory Papers - II and VI

(BOT. 502 and BOT. 506A/BOT. 506B)

Practicals Based on Bot. 502: Morphology and Systematics of Angiosperms

Practical - 1: Study of Leaf Morphology (as per theory): Phyllotaxy and Types of leaf

Practical - 2: Study of Inflorescences (as per theory)

Practical - 3: Study of Flower: Types of Flower and Forms of Corolla

Practical - 4 to 6: Study of **any six** plant families as per theory with respect to systematic position, morphological characters (vegetative and floral), floral formula and floral diagram (*sensu* Bentham and Hookers system)

Practical - 7: Identification of genus and species (any suitable) by using local, regional, state and national flora

NOTE : i) Excursion tour is compulsory

ii) Submission of photograph of any ten plants and tour report at the time of practical examination.

Practicals Based on Bot. 506 A: Analytical Techniques in Plant Sciences

Practical - 8 & 9: Extraction and Separation of amino acids by paper chromatography

Practical -10: Isolation of chloroplasts by solvent method

Practical - 11: Study of different microscopic techniques light and fluorescence by using photographs

Practical - 12: Preparation of different types of stains (Permanent and temporary)

Practical -13: Preparation of permanent slides (double staining)

Practical - 14 & 15: Computation of mean, mode, median, variance and standard deviation from the given data.

Practicals Based on Bot. 506B: Horticulture

Practical - 8: Study of Garden tools and equipment: Sprayer, Duster, Pruning knife, Sprinkler.

Practical - 9: Study of propagation requirement:

i) Media ii) Containers iii) Potting iv) Repotting

Practical - 10 & 11: Study of propagation methods:

a) Cutting b) Layering c) Budding d) Grafting

Practical - 12 to 15: Preparations of different types of fruit products (Any three)

a) Mix fruit Jam b)Wood apple/Guava Jelly

b) Lemon/Orange Squash c)Tomato ketchup

Note: Visit to any one Nursery Unit, Commercial orchard

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PRACTICAL PAPER - III

BOT. 509: Based on Theory Papers - III and IV

(BOT. 503 and BOT. 504)

Practicals Based on Bot. 503: Cell Biology and Genetics

Practical - 1: To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs

Practical - 2: Study of the Ultra structure of cell organelles with the help of Photomicrographs

Practical - 3: To prepare temporary stained preparation of mitochondria from onion peal using vital stain Janus green.

Practical - 4 & 5: Study of mitosis and meiosis (temporary mounts and permanent slides).

Practical - 6: Measure the cell size (either length or breadth/diameter) by micrometry

Practical - 7: Study of salivary gland chromosome in Chironomous larvae

Practicals based on Bot. 504: Plant Physiology and Biochemistry

Practical - 8: Estimation of soluble proteins by Lowery *et. al.* method.

Practical - 9 & 10: Demonstration:

a) Ringing experiment for path of solute translocation.

b) Geotropic Movement of root, by using germinating seeds

c) Phototropic movement

Practical - 11 & 12: Separation of sugar by paper chromatography

Practical - 13: Qualitative tests for primary metabolites starch, lipids and proteins by using available plant materials

Practical - 14 & 15: Qualitative tests for Secondary metabolites: alkaloids, terpenes, Flavonoids by using available plant materials.

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KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

(NAAC Re-Accredited)

SYLLABUS FOR CORE AND SKILL ENHANCEMENT COUESES IN BOTANY

As Per U. G. C. Guidelines

Based on

Choice Based Credit System (CBCS)

T. Y. B. Sc. BOTANY SEMESTER - WISE SYLLABUS

(Theory and Practicals)

SEMESTER - VI

To Be Implemented From

Academic Year 2020 - 2021

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Faculty of Science and Technology

SYLLABUS FOR CORE AND SKILL ENHANCEMENT COUESES IN BOTANY

As Per U. G. C. Guidelines

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T. Y. B. Sc. BOTANY SEMESTER - WISE SYLLABUS

(Theory and Practicals)

SEMESTER - VI

DISCIPLINE SPECIFIC COURSES

BOT. 601, Paper - I: Higher Cryptogams

BOT. 602, Paper - II: Gymnosperms & Paleobotany

BOT. 603, Paper - III: Molecular Biology

BOT. 604, Paper - IV: Economic Botany

SKILL ENHANCEMENT COURSE

BOT. 605, Paper - V: Floriculture

ELECTIVE COURSES

BOT. 606.A, Paper - VI: Herbal Techniques

BOT. 606.B, Paper - VI: Plant Breeding

PRACTICAL COURSES

BOT. 607, Practical - I: Based on BOT. 601 and BOT. 605

BOT. 608, Practical - II: Based on BOT. 602 and BOT. 606

BOT. 609, Practical - III: Based on BOT. 603 and BOT. 604

W. E. F. JUNE - 2020

SEMESTER - VI

Discipline	Core Course Type	Course Code	Course Title	Credits	Total Hrs./ Week	Total Teaching Hrs.	Total Marks (100)	
							CA	UA
Discipline Specific Course (DSC)	Paper-I	BOT.601	Higher Cryptogams	3	3	45	40	60
	Paper-II	BOT.602	Gymnosperms and Paleobotany	3	3	45	40	60
	Paper-III	BOT.603	Molecular Biology	3	3	45	40	60
	Paper-IV	BOT.604	Economic Botany	3	3	45	40	60
DSC Skill Enhanceme Course	Paper- V	BOT.605	Floriculture	3	3	45	40	60
DSC Electi Course (Any one)	Paper-VI	BOT.606 A	Herbal Technology	3	3	45	40	60
		BOT.606 B	Plant Breeding	3	3	45	40	60
DSC Core Practicals	Practical I	BOT.607	Practicals Based on BOT.601 and BOT.605	4	4 /Batch	60	40	60
	Practical II	BOT.608	Practicals Based on BOT.602 and BOT.606A/Bot.566B	4	4/Batch	60	40	60
	Practical III	BOT.609	Practicals Based on BOT.603 and BOT.604	4	4/Batch	60	40	60
Non-Credit Audit Cour (Any One)	Paper-VII	AC-610	Soft Skill	No Credit	2	30	100	--
		AC-611	Yoga					
		AC-612	Practicing Cleanliness					

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Equivalence of the T. Y. B. Sc. Botany CBCS Syllabus

Paper	Course	SEMESTER - VI CBCS Syllabus (New)	Course	SEMESTER - VI CGPA Syllabus (Old)
I	Bot. 601	Higher Cryptogams	Bot. 361	Gymnosperms & Paleobotany
II	Bot. 602	Gymnosperms and Paleobotany	Bot. 362	Anatomy & Embryology
III	Bot. 603	Molecular Biology	Bot. 363	Genetics, Plant Breeding and Evolution
IV	Bot. 604	Economic Botany	Bot. 364	Plant Biochemistry
V	Bot. 605	Floriculture	Bot. 365	Applied Botany
VI	Bot.606.A/ Bot.606.B	Herbal Technology/ Plant Breeding	Bot. 366.1/ Bot. 366.2/ Bot. 366.3/ Bot. 366.4	Botanical Techniques/ Medico botany and Pharmacognosy/ Horticulture/ Plant Protection

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus of T. Y. B. Sc. Botany w. e. f. June, 2020

CBCS Pattern

DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - VI

Paper - I

BOT. 601: HIGHER CRYPTOGAMS (Lectures: 45)

AIMS AND OBJECTIVES:

1. To study salient features of cryptogamic plants.
2. To make students aware of the status of cryptogams as a group in plant kingdom.
3. To study the life cycles of selected genera.
4. To study economic importance of cryptogamic plants.

Unit 1: Introduction (09 Lectures)

A) Bryophytes

1.1. General characters of Bryophyta

1.2. Classification of Bryophyta up to classes giving reasons with at least two examples of each class as per G. M. Smith (1955).

1.3. Alternation of generation in Bryophytes

1.4. Contribution of Indian Bryologist - Prof. Shiv Ram Kashyap

1.5. Economic importance

B) Pteridophytes

1.6. General characters of Pteridophytes

1.7. Classification of Pteridophytes up to classes giving reasons with at least two examples of each class according to Prof. G. M. Smith.

1.8. Contribution of Indian Pteridologist - S. S. Bir

1.9. Economic importance

Unit 2: A) Life History of *Marchantia* with respect to (11 Lecture)

2.1. Systematic position, habit and habitat

2.2. External and internal morphology of gametophytes.

2.3. Reproduction: Vegetative and sexual.

2.4. Structure of sex organs. (Development is not expected)

2.5. Fertilization,

2.6. Structure of sporophyte.

2.7. Dehiscence of capsule and dispersal of spores,

2.8. Structure and germination of spores

2.9. Graphical representation of Alternation of Generation

B) *Anthoceros*

2.10. *Anthoceros* is synthetic type discuss

2.11. Elaborate detail structure of sporophyte of *Anthoceros*

Unit 3: Life History of *Polytrichum* with respect to (07 Lecture)

3.1. Systematic position, habit and habitat
3.2. External and internal morphology of gametophytes.
3.3. Reproduction: Vegetative and sexual
3.4. Position and structure of sex organs. (Development is not expected)
3.5. Fertilization,
3.6. Structure of sporophyte,
3.7. Dehiscence of capsule and dispersal of spores,
3.8. Structure and germination of spores

Unit 4: Life History **(11 Lecture)**

A) *Psilotum* with respect to

4.1. Systematic position, habit and habitat
4.2. External and internal morphology of sporophyte
4.3. Reproduction, vegetative and asexual
4.4. Morphological nature and dehiscence of synangium.
4.5. Structure and germination of spores,
4.6. Structure of mature gametophyte (Prothallus),
4.7. Structure of mature male and female sex organ.
(Development is not expected)
4.8. Fertilization.
4.9. Structure of embryo.
4.10. Graphical representation of alternation of generation.

B) *Lycopodium* with respect to:

4.11. Systematic position, habit and habitat
4.12. External and internal morphology of sporophyte.
4.13. Reproduction: Vegetative and Asexual
4.14. Position and structure and dehiscence of sporangium.
4.15. Structure and germination of spores.
4.16. Structure of gametophyte
4.17. Structure of mature sex organs. (Development is not expected)
4.18. Fertilization.
4.19. Structure of embryo
4.20. Graphical representation of alternation of generation.

Unit 5: A) Life History of *Marsilea* with respect to: **(07 Lecture)**

5.1. Systematic position, Habit and habitat
5.2. External and internal morphology of sporophyte,
5.3. Reproduction
5.4. External and internal morphology of sporocarp,
5.5. Morphological nature and dehiscence of the sporocarp.
5.6. Structure of microspore and megaspore.
5.7. Structure of male and female gametophytes (Development is not expected)
5.8. Fertilization
5.9. Structure of embryo,
5.10. Graphical representation of alternation of generation,

B) Heterospory and its significance

REFFERENCE BOOKS

BRYOPHYTES AND PTERIDOPHYTES

1. Ganguli, H. G. and Kar, A. K. (2001). College Botany Vol. II. Books and Allied Press, Ltd. Kolkata, India.
2. Pandey, B. P. (1995). A Text Book of Botany Bryophyta. S. Chand & Co. Ltd. New Delhi, India.
3. Parihar, N. S. (1972). An Introduction to Embryophyta. Vol.1 Bryophyta, Central Book Depot, Hydrabad, India.
4. Puri, P. (1985). Bryophyta A Broad Perspective. Atma Ram and Sons, New Delhi, India. House. Pvt. Ltd. New Delhi.
5. Saxena A. K. and R. M. Sarabhai (1992). Text Book of Botany - Vol. II Embryophyta. Ratan Prakashan Mandir, Agra, India.
6. Sporne, K. R. (1965). The Morphology of Pteridophytes. The Hutchinson Univ. Lib., London, U.K.
7. Sundara Rajan, S. (1995). Introduction to Pteridophyta. Wiley Eastern Limited, New Delhi, India.
8. Vashishta, P. C. (1994). Botany: Pteridophyta. S. Chand & Co. Ltd. New Delhi, India.

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DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - VI

Paper - II

BOT. 602: GYMNOSPERMS AND PALEOBOTANY (Lectures: 45)

AIMS AND OBJECTIVES:

1. To study Gymnosperms with respect to distinguishing characters, comparison with Angiosperms, and classification.
2. To study the life cycles of *Pinus* and *Gnetum*.
3. To study the scope of Paleobotany, types of fossils and geological time scale.
4. To study the various fossil genera representing different fossil groups.

GYMNOSPERMS (30 Lectures)

Unit 1: General topics (06 Lectures)

1.1. Introduction
1.2. Distinguishing features of the group
1.3. Comparison of Gymnosperms with Angiosperms
1.4. Economic importance of Gymnosperms
1.5. Classification of Gymnosperms by K. R. Sporne up to orders giving reasons

Unit 2: Life cycle of *Pinus* with respect to (12 Lectures)

2.1. Distribution in India
2.2. Systematic position
2.3. External morphology
2.4. Internal morphology
  a) Primary structure of root, stem and leaf
2.5. Reproductive structure
  a) Male cone
  b) Structure & development of Male gametophyte
  c) Female cone
  d) Structure & development of Female gametophyte
2.6. Pollination
2.7. Fertilization
2.8. Structure of embryo and polyembryony
2.9. Seed structure and germination
2.10. Alternation of generation

Unit 2: Life cycle of *Gnetum* with respect to (12 Lectures)

2.1. Distribution in India
2.2. Systematic position
2.3. External morphology
2.4. Internal morphology
  a) Primary structure of root, stem and leaf

b) Anomalous Secondary growth in *Gnetum ula*

2.5. Reproductive structure

a) Male cone

b) Structure and development of Male gametophyte

c) Female cone

d) Structure and development of Female gametophyte

2.6. Pollination

2.7. Fertilization

2.8. Structure of embryo and polyembryony

2.9. Seed structure and germination

2.10. Alternation of generation

2.11. Resemblance with Angiosperms

PALEOBOTANY (15 Lectures)

Unit 4: Introduction **(06 Lectures)**

4.1. Introduction, definition and scope

4.2. Contribution of Birbal Sahani in Paleobotany

4.3. Definition of Fossil

4.4. Fossilization process, Conditions favorable for fossilization

4.5. Geological time scale. Eras, Periods, Epochs and major plant groups

4.6. Types of fossils: Impression, Compression, Petrifaction, Cast, Coal ball, Amber

Unit 5: Study of the following fossil groups w. r. t. morphology and structure **(09 Lectures)**

5.1. Psilopsida: *Rhynia*

5.2. Lycopsida: *Lepidostrobus* (Cone)

5.3. Sphenopsida: *Annularia* (Leaf)

5.4. Pteridopsperm: *Lyginopteris oldhamia* (Stem)

5.5. Bennettitales: *Cycadeoidea* (Flower)

5.6. Angiosperm: *Sahanipushpum* (Flower)

REFERENCE BOOKS

GYMNOSPERMS

1. Datta, S. C. (1966). Introduction to Gymnosperms. Asia Pub. House, New Delhi, India.
2. Datta, S. C. (1998). Systematic Botany, 4th Ed. New Age International Pvt. Ltd. New Delhi, India.
3. Gangulee, H. C. and Kar, A. K. (1998). College botany Vol. II. New central book agency (P) Ltd. Kolkata, India.
4. Chopra, G. L. (1962). Introduction to Gymnosperms. Asia Pub. House, New Delhi. India.
5. Vashishta, P. C. (1983). Botany for degree students: Gymnosperms. S. Chand & Co. New Delhi, India.

6. Sporne, K. R. (1967). Morphology of Gymnosperms. Hutchinson university library London,U. K.
7. Pandey, B. P. (1982). College botany Vol. II. S. Chand & Co. New Delhi, India.

PALEOBOTANY

1. Delevoryas, T. (1962). Morphology and Evolution of fossil plants. Holt Reihart & Winston, New York.
2. Surange, K. R. (1966). Indian fossil Pteridophytes. CSIR New Delhi, India.
3. Stewart, Wilson. N. (1983). Paleobotany and evolution of plants. Cambridge University Press.
4. Arnold, Chester, R. (1972). An introduction to Paleobotany. McGraw Hill Publ. Co. Ltd., New York.
5. Andrews Henry N. (1961). Studies in Paleobotany. John Wiley & Sons, USA.
6. Dick, M. W. and Edwards D. (1983). Contribution to Paleobotany. The white friars press ltd. Tonbridge.
7. Shukla, Ashok C. &Shital P. Misra (1975). Essentials of Paleobotany. Vikas Publ. House, New Delhi, India.
8. Chapman, Meyen S. V. and Hall, Fundamentals of Paleobotany. Cambridge University Press, Cambridge, London, U. K.
9. Norman, F. Hughes (1976). Paleobotany of Angiosperms origin. Cambridge University Press, Cambridge, London, U. K.
10. Mishra, S. R. (2010). Text Books of Paleobotany. Discovery Publication House Pvt. Ltd.

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DISCIPLINE SPECIFIC COURSE (DSC)

SEMESTER - VI

PAPER - III

BOT. 603: MOLECULAR BIOLOGY (Lectures: 45)

AIMS AND OBJECTIVES:

1. To study molecular biology in relation to genetic material, its inheritance, modification, replication
2. To study the mitochondria and chloroplast DNA
3. To study transcription, translation post translation modification of protein.
4. To study gene regulation in prokaryotes and eukaryotes.

Unit 1: Nucleic acids: Carriers of genetic information (02 Lectures)

1.1. Historical perspective

1.2. DNA as the carrier of genetic information Griffith's, Hershey & Chase, Avery, McLeod & McCarty experiment

Unit 2: The Structures of DNA and RNA / Genetic Material (10 Lectures)

2.1. Types of genetic material, Types of DNA

2.2. DNA Structure: Watson and Crick - historic perspective, Salient features of double helix

2.3. Organization of DNA: Prokaryotes (*E. coli*) and Eukaryotes

2.4. Types of RNA

2.5. Organelle DNA - Mitochondria and Chloroplast DNA

2.6. Chromatin structure - Nucleosome, Euchromatin, Heterochromatin - Constitutive and Facultative heterochromatin

Unit 3: DNA replication (10 Lectures)

3.1. General principles - bidirectional, semi conservative and semi discontinuous replication, RNA priming

3.2. Various models of DNA replication, including rolling circle, θ (theta) model of replication, replication of linear ds - DNA, replication of the 5'end of linear chromosome

3.3. Enzymes involved in DNA replication

3.4. The Central Dogma

3.5. Genetic code: Nature and properties

Unit 4: Transcription and Gene Regulation (10 Lectures)

4.1. Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation

4.2. Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E. coli.*

4.3. Eukaryotes: Eukaryotic transcriptional regulation (promoter enhancer and silencer, Gene battery) and post transcriptional regulation

Unit 5: Processing and modification of RNA (13 Lectures)

5.1. Split genes concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways

5.2. RNA editing and mRNA transport
5.3. Ribosome structure and assembly, mRNA,
Charging of tRNA, aminoacyl tRNA synthetases
5.4. Various steps in protein synthesis, proteins involved in
initiation, elongation and termination of polypeptides
5.5. Inhibitors of protein synthesis, Post translational modifications of proteins.

REFFERENCE BOOKS

1. Watson J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, 6th Ed. Pearson Benjamin Cummings, CSHL Press, New York, U.S.A.
2. Snustad, D. P. and Simmons, M. J. (2010). Principles of Genetics, 5th Ed. John Wiley and Sons Inc., U.S.A.
3. Klug, W. S., Cummings, M. R., Spencer, C. A. (2009). Concepts of Genetics, 9th Ed. Benjamin Cummings, U.S.A.
4. Russell, P. J. (2010). I - Genetics - A Molecular Approach, 3rd Ed. Benjamin Cummings, U.S.A.
5. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., Doebley, J. (2010). Introduction to Genetic Analysis, 10th Ed. W. H. Freeman and Co., U.S.A.
6. Verma, Agarwal, (2005). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company, New Delhi, India.
7. Powar, C. B. (2003). Genetics I & II. Himalaya Publishing House, Nagpur, India.
8. Sadhasivam and Manickam (2005). Biochemical Methods. New Age International Pvt. Ltd. New Delhi, India.

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DISCIPLINE SPECIFIC COURSE (DSC)
SEMESTER - VI
PAPER - IV
BOT. 604: ECONOMIC BOTANY **(Lectures: 45)**

AIMS AND OBJECTIVES:
1. To know useful bio resources of prime importance to mankind.
2. To acknowledge students about various groups of plants of the world as well of India.
3. To know botanical, chemical and nutritional values and value additions of food grains, legumes, sugars, vegetable, fruits, spices, etc.
3) To reveal new *vis-a-vis* forgotten food sources and their current practices.
4) To know the general account and uses of rubber, fiber and Timber.

Unit 1: Introduction and Origin of Cultivated Plants **(09 Lectures)**
1.1. Scope and Importance
1.2. Green Evolution in Indian context
1.3. Concept of Centers of Origin, their importance with reference to Vavilov's work
1.4. Examples of major plant introductions
1.5. Crop domestication and loss of genetic diversity
1.6. Evolution of new crops/varieties,
1.7. Importance of germplasm diversity

Unit 2: Cereals, Legumes and Millets, Sources of Sugars and Starches **(09 Lectures)**
2.1. Origin, morphology, processing and uses of Wheat and Rice
2.2. Origin, morphology and uses of Chick pea and Pigeon Pea
2.3. Origin, morphology, processing and uses of Pearl millet and Sorghum
2.4. Sources of Sugars, Morphology and processing of sugarcane
2.5. Products and byproducts of sugarcane industry
2.6. Morphology, propagation and uses of Potato

Unit 3: Spices, Beverages and Drugs **(09 Lectures)**
3.1. Spices: Listing of important spices, their family and part used
3.2. Economic importance with special reference to clove and black pepper
3.3. Beverages: Morphology, processing and uses of Tea and Coffee
3.4. Drugs: Morphology, processing, uses and health hazards of C*inchona* and *Papaver*

Unit 4: Oils and Fats **(09 Lectures)**
4.1. General description, classification of oils
4.2. Extraction, their uses and health implications of groundnut and Soybean (Botanical name, family & uses)
4.3. Essential Oils: General account, extraction methods of *Eucalyptus* oil comparison with fatty oils and their uses

Unit 5: Rubber, Fiber and Timber yielding plants **(09 Lectures)**
5.1. Para rubber: tapping, Industrial processing and uses

5.2. Fibres: Definition, Structure and classification based on the origin of fibers, morphology, extraction and uses of Cotton and Coir
5.3. Timber: Botanical Source, structure of wood and uses of Teak and *Pinus*

REFFERENCE BOOKS

1. Aiyer, A. K. Y. N. (1954). Field Crops in India. The Banglore Printing And Publishing Company, Banglore.
2. Bendre, Ashok and Ashok Kumar (1998 - 1999). Economic Botany for undergraduate Students. Rastogi Publications, Meerut, India.
3. Hill, A. F. (1952). Economic Botany, 2nd Ed. McGraw Hill Co. Pvt. Ltd. New York.
4. Pandey, S. N. and Archana (1996). Economic Botany. Vikas Publishing house, New Delhi.
5. Pal, B. P. (1996). Wheat Monograph. Council of Agricultural Research, New Delhi.
6. Pruthi, J. S. (1976). Spices and Condiments. National Book Trust, Delhi.
7. Sambamurthy, A. V. S. S. and Sambamurthy, N. S. (1889). A Textbook of Economic Botany. Wiley Estern Ltd. New Delhi.
8. Sharma, B. K. and Awasthi, P. B. (1984). Economic Botany. Prakash book Depot, Bareilley.
9. Kochhar, S. L. (2012). Economic Botany in Tropics. MacMillan & Co. New Delhi, India.
10. Wickens, G. E. (2001). Economic Botany: Principles & Practices, Kluwer Academic Publishers, The Netherlands.
11. Chrispeels, M. J. and Sadava, D. E. (1994). Plants. Genes and Agriculture, Jones & Bartlett.
12. Jacob Thankamma (1975). Foods, Drugs And Cosmetics: A Consumer Guide. The Mac millan Company of India Ltd. Delhi.
13. Parthasarathy, S. V. (1972). Sugarcane in India. K. C. P. Ltd., Madras.
14. Kannaiyana, S. and A. Gopalam (Ed.) (2007). Agro biodiversity: Crop Genetic Resources And Conservation. Vol. I. Associated Publishing Co., New Delhi, India.
15. Majumdar, D. K. (2011). Pulse Crop Production: Principles And Technologies. RHZ Learning (P.) Ltd., New Delhi, India.
16. Mitra, S. K. and Borse, T. K. (Ed.) (1996). Fruits: Tropical And Subtropical. Naya Prakash, Calcutta, India.
17. Patil, D. A. (2019). Food Crops: Evolution, Diversity and Advances. Scientific Publishers, Jodhpur, India.
18. Patil, D. A. and Dhale, D. A. (2013). Spices and Condiments: Origin, History and Applications. Daya Publishing House, New Delhi, India.
19. Patil, D. A. (2008). Useful Plants: Origin, History and Civilization. Navyug Publishers and Distributors, Delhi, India.

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DSC SKILL ENHANCEMENT COURSE

SEMESTER - VI

PAPER - V

BOT. 605: FLORICULTUR **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To know floriculture, its scope and importance.
2. To know the commercial floriculture.
3. To study the different features of garden.
4. To study methods of propagation.
5. To study diseases and pests of ornamental Plants.

Unit 1: Introduction: **(09 Lectures)**

1.1. History of gardening

1.2. Importance and scope of floriculture

1.3. Landscape gardening

1.4. Some Famous gardens of India

1.5. Landscaping Places of Public Importance

a. Landscaping highways

b. Landscaping of Educational institutions

Unit 2: Nursery Management and Routine Garden Operations: **(09 Lectures)**

2.1. Sexual and vegetative methods of propagation

2.2. Soil sterilization

2.3. Seed sowing: i) Pricking ii) Planting and transplanting
iii) Shading iv) Stopping or pinching
v) Defoliation vi) Wintering
vii) Mulching

2.4. Topiary

2.5. Role of plant growth regulators

Unit 3: Study of Ornamental Plants w.r.t. list of plants, description and cultivation method of at least two examples of each: **(09 Lectures)**

3.1. Flowering annuals

3.2. Herbaceous perennials

3.3. Climbers

3.4. Shade and ornamental trees

3.5. Ornamental bulbous and foliage plants

3.6. Cacti and succulents

3.7. Palms and Cycads

3.8. Ferns and Selaginellas

3.9. Bonsai

Unit 4: Principles of Garden Designs: **(09 Lectures)**

4.1. i) English ii) Italian iii) French
iv) Persian v) Mughal vi) Japanese gardens.

4.2. Features of a garden

i) Garden wall	ii) Fencing	iii) Path and roads
iv) Hedge	v) Edging	vi) Lawn
vi) Flower beds	vii) Shrubbery	viii) Borders
ix) Water garden.	x) Arches and Pergolas	

Unit 5: Commercial Floriculture: **(09Lectures)**

5.1. Factors affecting flower production

5.2. Production and packaging of cut flowers

5.3. Flower arrangements

5.4. Methods to prolong vase life

5.5. Cultivation of Important cut flowers

i) Carnation	ii) Aster	iii) Chrysanthemum
iv) Gerbera	v) Gladiolous	vi) Marigold
vii) Rose	viii) Lilium	

5.6. Diseases and Pests of Ornamental Plants: Rose and Gladiolus

REFFERENCE BOOKS

1. Arora J. S. (1998). Introductory Ornamental Horticulture. Kalyani Publishers Pvt. Ltd., W. Bengal.
2. Bhattacharjee S. K. (2004). Landscape gardening and design with plants.Pointer Publishers Pvt. Ltd., Jaipur.
3. Bhattacharjee S. K., and De L. C. (2005). Post harvest technology of flowers and ornamental plants. Pointer Publishers, Jaipur.
4. De L. C. (2011). Value addition in flowers and Orchids. New India Publishing Agency, New Delhi.
5. Nowak J., Rudnicki R. M. and Duncan A. A. (1990). Post Harvest handling and storage of cut flowers, florists greens and pottled plants. Timber Press, INC. Portland, Oregon.
6. Randhawa G. S, and Mukhopadhyay A. (2007). Floriculture in India. Allied Publishers Pvt. Ltd., New Delhi.
7. Randhawa, G. S. and Mukhopadhyay, A. (1986). Floriculture in India. Allied Publishers.

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DSC ELECTIVE COURSE

SEMESTER - VI

PAPER - VI

BOT. 606.A: HERBAL TECHNOLOGY **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To create optimum awareness and interest amongst the students about Medicinal Plants.
2. To conserve the biodiversity of Medicinal Plants in Maharashtra.
3. To strengthen the educational system and research on Medicinal Plants.
4. To increase students awareness about the efficacies of herbal drugs.
5. To develop awareness for utilization of herbal medicines for home remedies.

Unit 1: Herbal medicines **(06 Lectures)**

1.1. History, scope and importance
1.2. Definition of herbal medicines
1.3. Role of medicinal plants in Siddha systems of medicine
1.4. Herbal foods : future of pharmacognosy

Unit 2: Pharmacognosy **(09 Lectures)**

2.1 Systematic position and medicinal uses of the following herbs in curing various ailments -

i) Tulsi, ii) Ginger, iii) Fenugreek,
iv) Amla v) Ashoka (*Saraca indica*)

Unit 3: Herbal phytochemistry **(10 Lectures)**

3.1 Active principles and methods of their testing, identification and utilization of the medicinal herbs -

i) *Catharanthus roseus* (cardiotonic)
ii) *Withania somnifera* (drugs acting on nervous system)
iii) *Clerodendron phlomoides* (antirheumatic)
iv) *Centella asiatica* (memory booster).

Unit 4: Analytical pharmacognosy **(10 Lectures)**

4.1. Drug adulteration
4.2. Types and methods of drug evaluation
4.3. Biological testing of herbal drugs
4.4. Phytochemical screening tests for secondary metabolites
i) Alkaloids, ii) Phenolic compounds

Unit 5: Cultivation, harvesting, processing, storage, marketing and utilization of following medicinal plants **(10 Lectures)**

5.1. *Aloe vera*
5.2. *Mentha*

REFFERENCE BOOKS

1. Chopra, R. N., Nayar S. L. and Chopra, I. C. (1956). Glossary of Indian medicinal plants. C. S. I. R, New Delhi.
2. Kanny, Lall, Dey and Raj Bahadur, (1984). The indigenous drugs of India. International Book Distributors, Dehradun, India.
3. Agnes Arber, (1999). Herbal plants and Drugs. Mangal Deep Publications, Jaipur, India.
4. Sivarajan V. V. and Balachandran Indira (1994). Ayurvedic drugs and their plant source. Oxford IBH Publishing Co., Delhi,India.
5. Miller, Light and Miller, Bryan, (1998). Ayurveda and Aromatherapy. Banarsidass, Delhi, India.
6. Anne Green, (2000). Principles of Ayurveda. Thomsons, London.
7. Kokate C. K. *et al*. (1999). Pharmacognosy. Nirali Prakashan, Pune, India.

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DSC ELECTIVE COURSE

SEMESTER - VI

PAPER - VI

BOT. 606.B: PLANT BREEDING **(Lectures: 45)**

AIMS AND OBJECTIVES:

1. To introduce the student with science of plant breeding
2. To introduce the student with branch of plant breeding for the survival of human being from starvation.
3. To study the techniques of production of new superior crop verities.

Unit 1: Plant breeding **(08 Lectures)**

1.1. Introduction, Scope and objectives
1.2. Breeding systems: Inbreeding and outbreedings
1.3. Modes of reproductions in crop plants,
Self pollination, Cross pollination and Geitonogamy
1.4. Important achievements and undesirable consequences of
Plant breeding

Unit 2: Methods of Crop Improvements **(14 Lectures)**

2.1. Introduction
2.2. Centre of origin and domestification of crop plants
2.3. Plant genetic resources of wild relatives of domesticated crops
2.4. Procedure, advantages and limitations of
i) Plant introduction and Acclimatization
ii) Selection: Pure line selection, Mass selection and clonal selection
iii) Hybridization: Bulk method, Single cross and double cross method
Interspecific hybridization for improvement of clonal crops
2.7. Procedure, advantages and limitations

Unit 3: Male Sterility **(08 Lectures)**

3.1. Genetic male sterility
3.2. Cytoplasmic male sterility
3.3. Genetic Cytoplasmic male sterility
3.4. Use of male sterility in hybrid seed production

Unit 4: Inbreeding depression and heterosis **(07 Lectures)**

4.1. History
4.2. Genetic basis inbreeding depression and heterosis
4.3. Applications

Unit 5: Crop improvement and breeding **(08 Lectures)**

5.1. Role of followings in crop improvement with suitable examples one from each
a) Mutation breeding
b) Polyploidy breeding
c) Distant hybridization
d) Genetically modified crops

REFERENCE BOOKS

1. Agrawal, R. L. (1998). Fundamentals of Plant Breeding and Hybrid seed production. Oxford and IBH Publishing Co. New Delhi, India.
2. Allard, R.W. (1960). Principles of plant breeding. John Wiley and Sons, New York.
3. Hayes, H. K. (2017).Breeding Crops Plants.Shree Publishersbooks in India.
4. Chaudhary, H. K. (2001). Plant Breeding, Theory and Practice. Oxford IBH (P.) Ltd. New Delhi, India.
5. Gupta, P. K. (1998). Genetics, Plant Breeding and Evolution. Rastogi Publication, Meerut, India.
6. Xijendro Das, L. D. (1998). Plant Breeding. New age International Publication India.
7. Phundan, Sings (2006). Essential of Plant Breeding. Kalyani Publishers, New Delhi.
8. Poehlman, J. M. and Borthakur D. (1995). Breeding Asian Field Crops. Oxford IBH (P.) Ltd. New Delhi, India.
9. Phundan, Singh (2006). Principles of Plant Breeding.Rastogi Publication Meerut, India.
10. Sheenivas, Y. S. Seed Technology and Seed Pathology. Shree Publishers.
11. Sharma, J. R. (1994). Principles and Practice of Plant Breeding. Tata McGraw Hill Publishing Company Ltd. New Delhi.
12. Singh, B. D. (2006). Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
13. Singh, B. D. (1996). Plant Breeding. Kalyani Publishers, New Delhi.

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SEMESTER - VI

PRACTICAL COURSES

PRACTICAL PAPER - I

BOT. 607: Based on Theory Paper - I and V

(BOT. 601 and BOT. 605)

Practicals based on Bot. 601: Higher Cryptogams

Practical - 1 and 2: Study of life cycle of *Marchantia* w. r. t.

a) Systematic Position

b) External morphology: Mounting of rhizoids & scales

c) Internal morphology: i) T. S. of Thallus

ii) V. S. of thallus through gemma cup (P.S)

d) V. S. of antheridiophore (P. S.)

e) V. S. of archegoniophore (P. S.)

f) V. S. of sporophyte (P. S.)

Practical - 3: Study of life cycle of *Anthoceros* w. r. t.

a) Systematic Position

b) External morphology: Mounting of rhizoids

c) Internal morphology: i) T. S. of Thallus,

d) T. S. of thallus through antheridia (P. S.)

e) T.S. of thallus through archegonia (P. S.)

f) L. S. of sporophyte (P. S.)

Practical - 4: Study of life cycle of *Polytrichum* w. r. t.

a) Systematic Position

b) External morphology

c) Internal morphology

i) T. S. of axis

ii) T. S. of Leaf

d) L. S. of Sporophyte (P. S.)

Practical - 5: Study of life cycle of *Psilotum* w. r. t.

a) Systematic Position

b) External morphology

c) Internal morphology

i) T. S. of stem

ii) T. S. of rhizome (P. S.)

d) T. S. of synangium (P. S.)

Practical - 6: Study of life cycle of *Lycopodium* w. r. t.

a) Systematic Position

b) External morphology

c) Internal morphology: T. S. of stem

d) Mounting of Sporangium and Spores

e) L. S. Strobilus (P. S.)

Practical - 7 and 8: Study of life cycle of *Marsilea* w. r. t.

a) Systematic Position

b) External morphology
c) Internal morphology
  i) T. S. of stem/rhizome
  ii) T. S. of petiole
d) External structure of sporocarp
e) Internal structure of sporocarp in different planes:
  i) H. L. S. of sporocarp
  ii) V. T. S. of sporocarp
  iii) V. L. S. of sporocarp

NOTE: Study tour is compulsory. Students are expected to submit two forms or photographs of Bryophytes and Pteridophytes along with tour report.

Practicals based on Bot. 605: Floriculture

Practical - 9: Arrangement of Flowers
i) In Container   ii) Bouquet   iii) Floral carpet (Any Two)

Practical - 10: Technique and aftercare of a Bonsai.

Practical - 11 and 12: Study of different
i) Flowering annuals   ii) Herbaceous perennial   iii) Palms and Cycad plants. (One examples of each) with respect to Botanical name, ornamental value & place of choice.

Practical - 13 and 14: Study of different ornamental plants such as
i) Shrubs   ii) Trees   iii) Climbers   iv) Cacti & succulents
v) Ferns and Selaginellas (one examples of each) with respect to Botanical name, ornamental value & place of choice.

Practical - 15: Visit to suitable garden to study various salient features such as layout, components, list of plants and special features (if any) OR Visit to nearby nursery to observe various operations in nurseries.

Note: Students should submit Report of visit to garden/Nursery at the time of examination.

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PRACTICAL PAPER - II

BOT. 608: Based on Theory Paper - II and VI

(BOT. 602 and BOT. 606)

Practicals based on Bot. 602: Gymnosperms & Paleobotany

Practical - 1 and 2: Study of *Pinus* w. r. t.

a) Systematic Position
b) External morphology
c) Internal morphology
  i) T. S. of stem
  ii) T. S. of Needle
d) Male cone
  i) Morphology (Specimen)
  ii) L. S. of male cone (P. S.)
  iii) Microsporophyll (Specimen/P. S.)
  iv) Mounting of pollen grains
e) Female cone
  i) Morphology (Specimen)
  ii) L. S. of female cone (P. S.)
  iii) Megasporophyll (Specimen/P. S.)
  iv) V. S. of mature ovule (P. S.)

Practical - 3 and 4: Study of *Gnetum* w. r. t.

a) Systematic Position
b) External morphology
c) Internal morphology:
  i) T. S. of stem
  ii) T. S. of leaf
  iii) Secondary growth in the stem of *G. ula* (P. S.)
d) Morphology of male cone (Specimen)
e) Female cone
  i) Morphology (Specimen)
  ii) V. S. of mature ovule (P. S.)

Practical - 5 and 6: Study of different types of fossils.

Practical - 7 and 8: Study of the following with the help of slides/specimens

i) *Rhynia* ii) *Lepidodendron* iii) *Lepidostrobu*s
iv) *Calamites* v) *Annularia* vi) *Lyginopteris*
vii) *Cycadeoidea* viii) *Rhizopalmoxylan*

Practicals based on Bot. 606.A: Herbal Technology

Practical - 9 and 10: Study of following w. r. t. classification, botanical source, part used and medicinal uses of

i) Tulsi ii) Ginger iii) Fenugreek,
iv) Indian Goose berry v) Ashoka

Practical - 11 and 12: Study of botanical source, active principles and Medicinal uses of

i) *Catharanthus roseus* ii) *Withania somnifera*,
iii) *Clerodendron phlomoides* iv) *Centella asiatica.*

Practical - 13 to 15: Phytochemical screening test of
i) Alkaloids ii) Flavonoids iii) Steroids
iv) Triterpenoids v) Phenolic compounds

Bot. 606.B: Plant Breeding

Practical - 9: Study of factors promoting self pollination (By demonstration Flower/Photograph)
- Bisexuality (Hermaphroditism) ------------------- (Wheat, Rice)
- Cleistogamy -- (Wheat, Rice)
- Homogamy ------------------------------- (Tomato, Lady's finger)

Practical - 10: Study of factors promoting cross pollination (By demonstration Flower/Photograph)
- Dichogamy (i) Protandary --------------------------------- (Maize)
  (ii) Protogyny --------------------------- (Pearlmillet)
- Unisexuality (i) Monoecious ---------------- (Maize, Pumpkins)
  (ii) Dioecious ------------------ (Hemp, Asparagus)
- Self incompatibility ---------------------------- (Radish, Cabbage)

Practical - 11 &12: Techniques of Hybridization in Self Pollinated and Cross Pollinated Crops

Practical - 13: Estimation of heterosis
i) Standard heterosis
ii) Mid Parent heterosis
iii) Useful or Economic heterosis

Practical - 14: Pollen viability test by
i) Aceto Carmine method
ii) Sugar solution method

Practical - 15: To show artificial induction of polyploidy

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PRACTICAL PAPER - III
BOT. 609: Based on Theory Paper - III and IV
(BOT. 603 and BOT. 604)

Practicals based on Bot.603: Molecular Biology

Practical - 1: DNA isolation from any suitable material.
Practical - 2: DNA estimation by diphenylamine reagent/UV Spectrophotometry.
Practical - 3 and 4: RNA estimation by orcinol reagent/ UV Spectrophotometry.
Practical - 5: Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
Practical - 6: Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
Practical - 7: Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery *et. al*, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
Practical - 8: Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Practicals based on Bot.604: Economic Botany

Practical - 9 & 10: Study of cereals, Legumes and Millets
Wheat (habit sketch, L. S/T. S. of grain, starch grains)
Rice (habit sketch, study of paddy and grain, starch grains)
Chick pea, Pigeon Pea Pearl millet, Sorghum (Morphology of plant and grain)
Practical - 11 & 12: Sources of sugars and starches
Sugarcane (habit sketch; cane juice - micro chemical tests),
Potato (habit sketch, tuber morphology, T. S. of tuber to show localization of starch grains)
Legumes: Soybean, Groundnut (habit, fruit, seed structure).
Practical - 13: Spices, Beverages and Drugs
Morphology of Clove, Black pepper, Tea, Coffee, Papaver, Cinchona (Plant Specimen and products)
Practical - 14: Oils and fats
Coconut: Nut Morphology
Essential oil yielding plants: Habit sketch of *Eucalyptus* (specimens/ photographs).
Practical - 15: Rubber: a) Specimen, photograph/model of tapping, samples of rubber products.
b) Characteristic features of Coir and Teak/*Pinus* wood

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FACULTY OF SCIENCE & TECHNOLOGY

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS
FOR
T. Y. B. Sc. (PHYSICS)

(AS PER CHOICE BASED CREDIT SYSTEM PATTERN OF UGC)

(With effect from June - 2020)

Preamble

The University Grants Commission (UGC) has initiated several measures to bring equity, efficiency and excellence in the Higher Education System of country. The important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculum, teaching-learning process and examination and evaluation systems.

In that context in the last decade, North Maharashtra University, Jalgaon has taken several initiatives to upgrade and enhance the academic excellence, examination reforms and developing the skilled minds and skilled hands. As per the directions of UGC, from last year our KBC North Maharashtra University, Jalgaon has implemented the Choice Based Credit (CBCS) pattern to undergraduate programs run by various colleges affiliated to NMU, Jalgaon. As per the directions given by the Honorable Vice Chancellor, Pro-Vice Chancellor and Dean of the Faculty of Science and Technology of our university, one day workshop was organized for syllabus framing. The teachers of the affiliated colleges and university department were participated in the workshop of re-structuring the syllabi of T.Y.B.Sc. (Physics) as per the CBCS pattern and it has been finalized during the workshop and the same will be effectively implemented from the academic year 2020-21.

The main objective of the re-structuring the syllabus of T.Y.B.Sc. (Physics) is to create skilled minds and therefore expectation is to equip the students with the knowledge and understanding of concepts of physics rather than the ability to remember facts so that they may have a reasonable comprehensive and complete grasp of principles of physics. It is expected that the students should study physics with keen interest, develop their experimental skill and problem solving ability. The students should communicate their knowledge of Physics to the Society, to make them to understand physics around us. The students should use their knowledge of Physics for betterment of our Society, our nation and the World.

Board of Studies (Physics),
North Maharashtra University, Jalgaon

OBJECTIVES

1. To provide education in physics of the highest quality at the undergraduate level and generate graduates of the caliber sought by industries and public service as well as academic teachers and researchers of the future.

2. To acquire deep knowledge in fundamental aspects of Physics and basic knowledge in the specialized thrust areas like Thermodynamics, Basic electronics, Waves, Sound, Optics, LASERS, Energy harvesting and electrical circuit skills.

3. To develop ability among the students to identify, remember and grasp the meaning of basic facts, concepts and principles of Physics.

4. To develop observational skills, confidence in using scientific equipment and relate the knowledge of scientific concepts to quantitative and physical measurement.

5. Acquire knowledge, skills, working methods and ways of expression which will reflect on all round development of the students' attitudes towards scientific thinking and its applications.

6. To develop attitudes such as concern for accuracy and precision, objectivity, and Enquiry.

7. The overall aim is to provide comprehensive knowledge and understanding in the relevant fields and enable students to pursue the physics subject at an advanced level later and to attract outstanding students from all back grounds.

BOS (PHYSICS)-Faculty of Science & Technology

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon

Class: **T. Y. B. Sc.** Subject: **Physics**

Choice Base Credit System (With effect from June 2020)

The Board of Studies in Physics has unanimously accepted the revised syllabus (as per CBCS pattern) prepared by different committees, discussed and finalized in the **Online Workshop on Curriculum Development in Physics at T. Y. B. Sc.** held on15th and 16th May 2020.

The titles of the papers for T.Y.B.Sc. (Physics) are as given below:

Sem	Course type	Course code	Course title	Credits	Total hrs /week	Total teaching periods	Total marks	
							CA	UA
V	Discipline specific Course (DSC)	PHY 501	Mathematical Physics	3	3	45	40	60
		PHY502	Solid State Physics	3	3	45	40	60
		PHY 503	Atomic and molecular physics	3	3	45	30	60
		PHY 504(A) Or PHY 504(B)	Electronics-II Or Instrumentation -II	3	3	45	40	60
	Skill Enhancement course (SEC)	PHY 505	Solar Energy and applications	3	3	45	40	60
	DSE Elective course (Any one)	PHY 506(A) PHY 506(B) PHY 506(C) PHY 506(D) PHY 506 (E)	Technical Electronics- I or Refrigeration and Air conditioning- I or Vacuum Technology-I or Microprocessor-I or Programming in C++ I	3	3	45	40	60
	DSC CORE Practicals	PHY 507	Physics Practical I	2	4 (per batch)	60	40	60
		PHY 508	Physics Practical II	2	4 (per batch)	60	40	60
		PHY 509	Physics Practical III or Project	2	4 (per batch)	60	40	60
	Non credit audit course (Any one)	AC 501(A)	NCC	No credit	2	30	100	
		AC 501(B)	NSS					
		AC 501 (C)	Sports					
			Total credit	24				

Sem	Course type	Course code	Course title	Cre dits	Total hrs /week	Total teaching periods	Total marks	
							CA	UA
VI	Discipline specific Course (DSC)	PHY 601	Quantum mechanics	3	3	45	40	60
		PHY602	Material Science	3	3	45	40	60
		PHY 603	Nuclear Physics	3	3	45	30	60
		PHY 604	Modern Physics	3	3	45	40	60
	Skill Enhancement course (SEC)	PHY 605	Basic Instrumentation Skills	3	3	45	40	60
	DSE Elective course (Any one)	PHY 606 (A) PHY 606 (B) PHY 606 (C) PHY 606 (D) PHY 606 (E)	Technical Electronics- I or Refrigeration and Air conditioning- II or Vacuum Technology-II or Microprocessor-I or Programming in C++ II	3	3	45	40	60
	DSC CORE Practicals	PHY 607	Physics Practical I	2	4 (per batch)	60	40	60
		PHY 608	Physics Practical II	2	4 (per batch)	60	40	60
		PHY 609	Physics Practical III or Project	2	4 (per batch)	60	40	60
	Non credit audit course (Any one)	AC 601(A)	Soft skill	No credit	2	30	100	
		AC 601(B)	Yoga					
		AC 601(C)	Practicing Cleanliness					
			Total credit	24				

Note: The industrial/study tour is compulsory for students of T. Y. B. Sc. (Physics).

Semester V: (DSC): Physics paper I
PHY 501: Mathematical physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the concepts of Mathematical physics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Mathematical physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and knowledge of Mathematical physics to understand and solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Vector Analysis
Gauss divergence theorem, Stokes' theorem, Green's first and second theorem, Green's theorem in the plane. (Statements, proofs and problems) **(5P, 6M)**
Unit 2: Differential Equation
Introduction to Cartesian (X, Y, Z), Spherical polar (r, θ, φ) and Cylindrical (ρ, φ, z) co-ordinate systems and their transformation equations, Degree, order, linearity and homogeneity of partial differential equation, Method of separation of variables in Cartesian, Spherical polar and Cylindrical co-ordinate system (Wave equation and Laplace's equation), Singular points, Singular points of Legendre and Hermite differential equation, Statement of Fuche's theorem, Frobenius method of series solution, series solution of linear simple harmonic oscillator and Legendre differential equation **(11P, 16M)**
Unit 3: Special Functions
Generating functions for Legendre Polynomial P_n (x), Hermite polynomial H_n (x),and Bessel functions of first kind $J_n(x)$. Proof of following properties
1) $(n+1) P_{n+1}(x) = (2n+1) \times P_n(x) - n P_{n-1}(x)$. 2) $P_n(x) = P'_{n+1}(x) - 2x P'_n(x) + P'_{n-1}(x)$.
3) $H_{n+1}(x) = 2 \times H_n(x) - 2n H_{n-1}(x)$. 4) $H'_n(x) = 2n H_{n-1}(x)$.
5) $J_{n+1}(x) + J_{n-1}(x) = 2n / x J_n(x)$. 6) $J_{n-1}(x) - J_{n+1}(x) = 2 J'_n(x)$. **(8P, 10M)**
Unit 4: Complex Analysis
Complex numbers and their graphical representation, Argand diagram, Conjugate of a complex number, Basic mathematical operations with complex numbers, Euler's formula, De-Moivre's theorem, Roots of complex numbers, Functions of complex variables, Analyticity and Cauchy - Riemann conditions, Singular functions, Examples. **(10P, 14M)**
Unit 5: Special Theory of Relativity
Newtonian relativity, absolute space, Galilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorent'z transformation equations, Length contraction, time dilation, relativity of simultaneity, variation of mass with velocity, addition of velocities, mass-energy relation, energy momentum relation. **(11P, 14M)**
(Total: 45 Periods, 60 Marks)

References:

1. Mathematical Physics: B.S. Rajput, Pragati Prakashan (19th Edition, 2007).
2. Mathematical Physics: B. D. Gupta.
3. Mathematical Methods for Physics: G. Arfken, Hens Weber (4th Edition, 1995).
4. Mathematical Methods in the Physical Science: Mary L. Boas.
5. Vector Analysis: Murray R. Spiegal, Schaum's series.
6. Introduction to Special theory of Relativity – Robert Resnick, Wiley Eastern Ltd.
7. Mathematical physics: Ghatak
8. Complex variables and applications: J. W. Brown

Semester V: (DSC): Physics paper II
PHY 502: Solid State physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Solid state Physics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Solid state Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Solid state Physics understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: The Crystal Structure
Classification of solids, Lattice, Basis & crystal structure, translational vector, Unit cell, Primitive unit cell, symmetry operations, Types of lattices (2D & 3D), Miller indices, Interplaner spacing, Number of atoms per unit cell, co- ordination number, atomic radius and packing fraction for SC, BCC and FCC structures, Study of CsCl, NaCl and ZnS structures, Concept of reciprocal lattice and its properties with proofs. **(10P, 14M)**
Unit 2: X-Ray Diffraction
Crystal as a grating for X-rays, Bragg's diffraction condition in direct lattice and reciprocal lattice, Ewald's construction, X-ray diffraction methods: Laue method, Rotating crystal method and Powder method, Analysis of cubic crystal by powder method, Brillouin zones (1D & 2D). **(08P, 10M)**
Unit 3: Cohesive energy and Bonding in solids
Cohesive energy and formation of molecules, Definition of dissociation energy of molecule, Types of bonding, Ionic bond, Covalent bond, Molecular bond, Metallic bond and Hydrogen bond, Madelung energy, Madelung constant for one dimensional ionic crystal. **(09P, 12M)**
Unit 4: Lattice vibrations and Thermal Properties
Lattice heat capacity, Classical theory of specific heat, Einstein's theory of specific heat, Vibrational modes in one dimension monoatomic lattice, Debye's model of specific heat of solids, Limitations of Debye model. **(09P, 12M)**
Unit 5: Free electron theory of metals and Band theory of solids
Drude-Lorentz classical theory, Sommerfield's quantum theory: Free electron gas in 1-D and 3-D, Fermi level and fermi energy, Density of states, Formation of Energy band, Distinction between metals, semiconductors and insulators, Hall Effect, Hall co-efficient and mobility. **(09P, 12M)**
(Total: 45 Periods, 60 Marks)

References:
1. Introduction to Solid State Physics: Charles Kittle.
2. Solid State Physics: A.J. Dekkar
3. Solid state Physics: R. L. Singhal
4. Solid State Physics: S.L. Gupta, V. Kumar.
5. Solid State Physics: S.L. Kakani, C. Hemrajan
6. Solid State Physics: C.M. Kachhava
7. Solid State Physics: R.L.Singhal, Kedar Nath, Ram Nath & Co.
8. Fundamentals of Solid State Physics: B.S. Saxena, R.C. Gupta, P.N. Saxena, Pragati Prakashan, Meerut
9. Concepts of Solid State Physics: J.N. Mandal, Pragati Prakashan, Meerut.
10. Solid State Physics: R. K. Puri and V. K. Babbar
11. Solid State Physics, H.Ibach and H Kutha, Springer (Online available book)

Semester V: (DSC): Physics paper III
PHY 503: Atomic and Molecular physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Atomic and Molecular Physics to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Atomic and Molecular Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and knowledge of Atomic and Molecular Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Vector Atom Model

Introduction, Quantum numbers, Physical interpretation of quantum numbers, Electron spin, Larmor precession of electron orbit, Pauli's exclusion principle, Definition of L-S coupling and j-j coupling, Spin-Orbit interaction, Spectral terms, Selection rules, Spectra of single valence electron system (sodium), Problems. **(08P, 11M)**

Unit 2: Two Valence Electron System

Introduction, Spin-spin and orbit-orbit interaction, L-S and j-j coupling schemes, Singlet triplet separations, s-p and p-d configuration in L-S coupling and j-j coupling, Lande Interval rule, Spectra of Helium, Problems. **(10P, 13M)**

Unit 3: Zeeman & Paschen Back effect

Introduction, Magnetic dipole moment, , Zeeman Effect: Experimental set up, Normal and Anomalous Zeeman Effect for single valence electron system, Lande 'g' factor for two valence electron system (L-S and j-j coupling), Paschen Back effect for single valence electron system, Problems. **(10P, 13M)**

Unit 4: X-ray spectra

Origin and nature of X-ray, Characteristic X-ray spectra, Moseley's law and its importance, Energy level of Cadmium, Regular and Irregular doublets and their laws, Applications of X-ray (List only) **(07P, 10M)**

Unit 5: Molecular spectra

Introduction, Regions of electromagnetic spectrum, Types of molecular spectra, Rotational spectra of rigid diatomic molecule, Rotational energy levels of rigid diatomic molecule, Vibration of atoms in a diatomic molecule, Vibrational energy levels for Diatomic molecule, Raman spectra – Experimental set up, Explanation of Stoke's and Anti-stoke's lines, Applications of Raman effect. **(10 P, 13M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Atomic Spectra: H.E. White, McGraw Book Company, Inc.
2. Fundamental of Molecular spectroscopy: C.N. Banwell, Tata McGraw hill, 3rd edition.
3. Spectra of Diatomic Molecules: G Hertzberg, D Van Nastrand compony, Inc., NewYork.
4. Perspectives of Modern Physics: Arthur Beiser, McGraw Hill Kogakusha Ltd, Tokyo.
5. Atomic spectra and Molecular spectra: Raj kumar, Kedarnath Ramnath Prakashan.
6. Introductory Raman spectroscopy: Elsevier publication.
7. Theoretical Atomic physics (Fourth Edition): Harald Friedrich.
8. Physics of Atoms and Molecules(Second edition):B. H. Bransden & C. J. Joachain.
9. The fundamentals of Atomic and Molecular Physics: Robert L. Brooks.

Semester V: (DSC): Physics paper IV
PHY 504(A): Electronics-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Electronics and Digital Electronics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Electronics and Digital Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Electronics and Digital Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Transistor biasing and Transistor amplifiers
Need of biasing, Different methods of biasing (only list), Voltage Divider bias method in detail, Single stage RC coupled Common emitter amplifier: Working, voltage gain, frequency response and bandwidth, Definition of Voltage amplifier and Power amplifier, Class A, B , C and AB power amplifiers (only load line diagram and explanation) and application list of each type. **(09P, 11M)**
Unit 2: Transistorised Sinusoidal Oscillators
Types of feedbacks, Barkhausen Criterion, Oscillatory circuit (tank circuit), Types of Oscillators (List only), Hartley oscillator, RC phase shift Oscillator **(04P, 07M)**
Unit 3: Semiconductor switching devices
FET: Types (n-channel and p-channel), Constructional detail, electronic symbol, working principle and I-V Characteristics, FET parameters, Introduction to MOSFET, Applications: FET as a VVR, FET as an amplifier.
UJT: Constructional detail, Equivalent circuit, symbol, working principle and I-V Characteristics, Applications: UJT as a switch, UJT as a relaxation oscillator
SCR: Constructional detail, symbol, Equivalent circuit of SCR, working principle and I-V Characteristics, Transistor analogy and its working, Important terms (break over voltage, holding current, forward current rating), Applications: SCR as a switch, Controlled rectification using SCR. **(09P, 12M)**
Unit 4: Digital Electronics
A) Flip-flops: Logic circuit, truth table, working and symbols of R-S Flip Flop, J-K Flip Flop. **(06 P, 08M)**
B) Counters: Types of counters (Asynchronous and Synchronous), 3 bit Asynchronous up counter (Serial counter), 3 bit Asynchronous down counter, 3-bit Asynchronous Up-down counter, 3 bit Synchronous up counter (Parallel counter), modulus of counter, mod-3 counter, mod-5 counter, and mod 10. **(07P, 10M)**
C) Data Processing circuits:
Multiplexer (2 to 1 & 4 to 1 line), De-multiplexer (1 to 2 & 1 to 4 line), Decoder (1 to 2 & 1 to 4 line, BCD to decimal decoder), Encoder (Decimal to BCD encoder). **(05P, 6M)**
D) Timer: Functional block diagram of IC-555 (Timer), Pin configuration, Astable, Monostable and Bistable multivibrator using IC 555, Application: Square wave Generator **(05P, 6M)**
(Total: 45 Periods, 60 Marks)

References

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics: B. L. Theraja, S. Chand Publications, New Delhi.
3. Digital Principles and Applications – Malvino and Leach, McGraw-Hill Publication.
4. Electronic Principles – A. P. Malvino, Mc-Graw-Hill Publishing House.
5. Modern Digital Electronics – R. P. Jain, Tata McGraw-Hill Pvt. Ltd., New Delhi.
6. Integrated Circuits - K. R. Botkar, Khanna Publishers (2004).
7. Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition.
8. Electronic Devices and Circuits – Allen Mottershead, Good year publishing Company.

Semester V: (DSC): Physics paper IV
PHY 504(B): Instrumentation-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

This course is aimed at introducing the fundamentals of Instrumentation to Under Graduate students.

Course objectives:

1. To impart knowledge of basic concepts in Instrumentation.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:

Learner will be able to ….

1. Apply the concept and use of knowledge of Instrumentation to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Introduction to Instrumentation

Definitions: Resolution, Threshold, Range and span, Hysteresis, Dead band, Backlash, Drift, Impedance loading and matching. Functional elements of measurement system (Brief description), Classification of instruments- Deflection and Null type, Manually operated and automatic type, Analog and Digital types, Self-generating and power-operated types, Contacting and Non-contacting types. Dynamic Characteristics of Instruments: Dynamic response of zero order, First order, & Second order instrument.**(10P, 12M)**

Unit 2: Transducers

Introduction, Analog transducers- Electromechanical type, Potentiometric Resistance-type, Inductive type, Self-generating type, Non-self generating type, Capacitance type, Piezo-electric type, Resistance-strain gauges, Opto-electric transducer, Digital transducers: Frequency domain transducers, Digital encoders, Optical encoders, Shaft encoder. **(11P, 16M)**

Unit 3: Data Acquisition Systems

Introduction, Data converters, Digital to analog converters- Binary weighted and R-2R ladder. Analog to digital converters - Successive approximation method, Single and dual slopeintegration type ADC. Data transmission elements-Electrical-type, Pneumatic-type, Positiontype,Radio-Frequency type. **(12P, 16M)**

Unit 4: Data Presentation Systems

Indicating elements- Digital voltmeters, Digital Multimeter, CRO (Analog & Digital),Recorders- Strip chart, X-Y recorder,Digital data recording (CD Recording system).Display elements- Classification of displays, Display devices- LED, LCD, 7-segment display, Dot matrix display, Electro luminescent display. **(12P, 16M)**

(Total: 45 Periods, 60 Marks)

References:

1. Instrumentation: Measurement and analysis - Nakra and Chaudhary
2. Electronic Instrumentation – H.S. Kalsi
3. Electronic Instrumentation and Measurement Techniques - Helfrick and Cooper
4. Instrumentation: Device and system - Rangan, Mani, Sharma
5. Transducers & Instrumentation- D.V.S. Murty, PHI Publication.
6. Electrical and Electronic Measurement & Instrumentation - A.K. Sawhney
7. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company.
8. Data Converters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited.
9. Audio and Video Engineering System: R.G. Gupta, Tata McGraw-Hill Publishing Company.

Semester V: (SEC): Physics paper V

PHY 505: Solar energy and applications

(Credits: 03) :(45 Lectures 60 Marks)

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Course description:

The aim of this course is not just to impart theoretical knowledge solar energy fundamentals and applications to the students but to provide them with exposure and hands-on learning wherever possible.

Course objectives:

1. To impart knowledge of basic concepts of clean, safe and affordable energy.
2. To provide the knowledge about variety of solar energy applications.
3. To provide the knowledge and methodology of conversion of solar energy into heat& electricity.

Course outcome:

Learner will be able to ….

1. Apply the concept of use of knowledge of energy resources, solar radiations and conversion to real life problem.
2. Understanding of the course will create scientific temperament.
3. To impart knowledge of basic concepts of solar cell fundamentals.
4. To provide the knowledge and methodology of conversion of solar energy into electricity.

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Unit 1: Solar Radiation:

The Sun, structure of the sun, solar constant, spectral distribution of extra-terrestrial radiation, Solar radiation at the earth's surface (terrestrial radiation), solar time and equation of time, Definitions: air mass, beam radiation, diffuse radiation, global radiation, irradiance, solar insolation. Solar radiation geometry, Empirical equation (derivation not expected) for Monthly Average: 1) Daily global radiation, 2) Daily diffuse radiation, 3) Hourly global radiation, 4) Hourly diffuse radiation. Solar radiation on tilted surfaces. Instruments for measuring solar radiation: Pyranometer, Pyrheliometer. **(05P, 08M)**

Unit 2: Solar Collectors:

Flat plate collector: Types (Liquid flat-plate type, Evacuated Tube collector type, flat-plate with Al-insulator, Polymer solar collector), materials for collectors (Absorber plate, Insulation and Cover plate),Efficiency of flat plate collector, Loss coefficients and Heat transfer, Heat Removal Factor, Improvement in efficiency.

Solar Concentrating Collectors: Flat plate collector with reflector, Cylindrical parabolic collector, Thermal analysis, Performance analysis. **(10P, 12M)**

Unit 3: Solar Photovoltaics:

A P-N junction, Energy level diagram of semiconductors, Fermi level in doped semiconductors, Photovoltaic principals, Materials for Solar cell, Single crystal silicon cell: Principle, construction, working, equivalent circuit, I-V characteristics of solar cell, Fill factor, Power-voltage characteristics of solar cell, Maximum conversion efficiency, Actual conversion efficiency, Limitations to cell efficiency, Multicrystalline silicon cell, Thin Film Solar Cell, Short circuit current, Open circuit voltage, Maximizing the performance, Cell size. **(10P, 12M)**

Unit 4: Solar Thermal Applications:

Solar water heater: Direct natural circulation type, Direct forced circulation type, Design consideration of solar water heater, Series and Parallel Arrays, Solar drying of food (Direct type and Indirect mode type),Solar cooling and refrigeration, Solar thermal power generation, Solar furnace (Direct incident type). **(10P, 14M)**

Unit 5: Solar PV Applications:

PV Systems: Classification, Basic Photovoltaic power system, Stand-alone PV system, Solar Cell Modules (Solar PV arrays), Series and Parallel combination of PV Modules, Grid-connected system, Solar power satellite, Power conditioning and control. Design of PV System: Array size and Battery size.

Energy storage: electro chemical batteries, large capacity approaches.

PV Applications: Industrial applications, Social applications, Consumer applications. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

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Demonstrations and Experiments:

(Note: Total 4 experiments are expected to be taken in the LAB by the teacher of this course while teaching the course.)

A) Solar Thermal Applications (Any two of the following)

1. Study of Solar Box Cooker
2. Study of Concentrating type Solar Cooker.
3. Solar Energy Measurements using Pyranometer.
4. Solar Energy Measurements using Pyrheliometer.
5. Study of Solar still for Water distillation.
6. Study of Solar Dryer: Hot air collector.

B) Solar PV Applications (Any two of the following)

1. Measurement of V_{OC} and I_{SC} of a Solar cell.
2. Determination of I-V & P-V Characteristics of a Solar cell.
3. Determination of I-V & P-V Characteristics of Series and Parallel combination of PV Modules.
4. Effect of Shading on Solar PV Module Output Power.
5. Study of Power versus load characteristics of Solar Photovoltaic panel
6. Study of Solar Lantern/ Street light

Note: For Solar energy modelling techniques, the software used for simulation in solar energy field, comparative review of software for solar photovoltaics, solar thermal systems and buildings. Use of software such as TRNSYS, PVSYST, PVSOL, SAM, SOLTRACE, HOMER, Meteonorm etc is advised.

References:

1. Solar Energy- S. P. Sukhatme and J K Nayak, Fourth Edition, Tata Mac Graw Hill Co. Ltd.
2. Solar Energy Fundamentals and Applications – H P Garg and J Prakash, Tata McGraw Hill Co. Ltd.
3. Solar Energy Utilisation – G D Rai, Khanna Publishers.
4. Solar Engineering and Thermal Processes – Duffie J. and W. Beckman (1991), John Willey and Sons Inc.
5. Solar Power Engineering – Magal B. S. (1990), Tata Mac Graw Hill Co. Ltd.
6. Renewable Energy Sources and Conversion Technology – Bansal N. K., M. K. M. Meliss (1990), Tata Mac Graw Hill Co. Ltd.

Semester V: (DSE): Physics paper VI
PHY 506(A): Technical Electronics-I
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Technical Electronics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Technical Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept of use of knowledge of Technical Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Components and devices
Resistors, Capacitors, Inductors (Types, construction and specification), Identification of resistor and capacitor values, Transformers: Types, (Single phase power transformer, auto transformer, isolation, AF, RF, IF), Switches, Types of switches, Relay: Types (list only), Electromagnetic relay: Principle, Construction and Working. [Ref. 1 to 6] **(06P, 09M)**

Unit 2: Optoelectronic Devices
LED (Construction, Working & Applications), Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (Construction, working, characteristics & applications), Introduction to phototransistor. [Ref. 2 to 5, 8] **(05P, 08M)**

Unit 3: Printed Circuit Board
Idea of PCB, advantages, copper clad, Etching processes, Different steps for making PCB, Precautions while making PCB, Principle of Photolithography (For PCB).[Ref.2,3 & 4] **(06P, 7M)**

Unit 4: DC Power Supplies
Block diagram of unregulated and regulated power Supply, their merits and demerits, Series regulated power supply, Voltage regulation (Load and Line). Study of Monolithic voltage regulators: Precision voltage regulator (IC 723), Three-terminal general purpose regulators ICs- 78xx and 79xx.[Ref 1 to 3, 15]
(07P, 10M)

Unit 5: Operational amplifier and its applications
Introduction to differential amplifier, Block diagram of Opamp, Schematic symbol and Pin diagram of IC 741, Important terms of OPAMP such as input impedance, output impedance, input offset voltage, open loop voltage gain, input bias current, slew rate. Ideal and practical parameters of Op-Amp, Concept of virtual ground, inverting and non-inverting amplifier with gain expressions, off-set null, Applications: Adder, Subtractor, Integrator, Differentiator, Comparator. [Ref 2, 3, 13,14] **(12 P, 14M)**

Unit 6: Data Converters
D to A Converters: Resistive divider network, Binary ladder network. A to D Converters: Successive approximation type, Single slope, Dual slope, Voltage to Time, Voltage to Frequency. [Ref. 7 to 12]
(09P, 12M)
(Total: 45 Periods, 60 Marks)

References:

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics (Solid State): B.L. Thereja, Publisher:S. Chand &Company, New Delhi.
3. Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York,
4. A Textbook of Applied Electronics – R S Sedha, Publisher: S Chand & Company, New Delhi.
5. Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited,New Delhi.

6. Electronic components and Materials-Principles, Manufacture and Maintenance: S. M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Measurement and Instrumentation Principles: Alan S. Morris., Publisher: Butterworth-Heinemann.
8. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9. Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Data Converters–: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
11. Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
12. A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
13. Op-Amps & Linear Integrated Circuits - R. A. Gaikwad, Publisher: Pearson.
14. Operational Amplifier - G. B. Clayton
15. Integrated Circuits - K. R. Botkar, Khanna Publishers (2004).
16. Optoelctronics: J. D. Ryder
17. Power supplies: B. S. Sonde

Semester V: (DSE): Physics paper VI
PHY 506(B): Refrigeration and Air conditioning-I
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Refrigeration and Air conditioning to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Refrigeration and Air conditioning.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Refrigeration and Air conditioning to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Heat Transfer:
Introduction, Conduction through slab, pipe, hollow sphere, Convection, Heat transfer by convection, Expression for heat transfer coefficient ,combined conduction and convection heat transfer, Fins and their applications. (Ref. 1: Chapter -15) **(6L, 10M)**

Unit 2: Air Refrigeration system:
Introduction, Reversed Carnot cycle and as most efficient refrigerator, C.O.P. and its dependence on source and sink temperature, Bell-Coleman air refrigeration system, Advantages and disadvantages of air refrigeration system. (Ref. 1: Chapter - 3) **(7L, 10M)**

Unit 3: Vapour Refrigeration system:
i) **Simple Vapour Compression Refrigeration system**:
Vapour compression refrigerator, Construction of various lines on T–S chart, P- H diagram for vapour compression refrigeration, Analysis of vapour compression system Advantages and disadvantages of vapour compression refrigeration over air refrigeration system. (Ref.1: Chapter-4)
ii) **Absorption Refrigeration system:**
Introduction, Simple absorption system, Practical ammonia absorption system, C.O.P. of the absorption refrigeration system, Domestic Electrolux refrigerator, Advantages and disadvantages of absorption refrigeration over compression refrigeration system. (Ref. 1: Chapter -6) **(14L, 16M)**

Unit 4: Refrigerants:
Classification of refrigerants: primary and secondary refrigerants, Desirable thermodynamic, safe working and physical properties of refrigerants, important refrigerants, refrigerant nomenclature, selection of refrigerant. (Ref.1: Chapter -11) **(06L, 8M)**

Unit 5: Refrigeration equipments:
Compressors: Functions, Reciprocating compressor, hermetically sealed compressor, Rotary compressor with sealing blade and eccentric motor. **Condensers:** Functions, Air cooled and water cooled condensers, Evaporative condensers, Cooling towers. **Evaporators:** Functions, Primary and Secondary evaporators, flooded evaporators, Dry expansion systems, Shell & coil evaporators.
Expansion Devices: Functions, Automatic expansion valve, Thermostatic expansion valve, Solenoid control valve, Low side and high side float valves. (Ref.1: Chapter -13)
(12 L, 16M)
(Total: 45 Periods, 60 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar. Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd Edition
3. Principles of Refrigeration: Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition

Semester V: (DSE): Physics paper VI
PHY 506(C): Vacuum Technology-I
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Vacuum technology to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Vacuum technology.
2. To introduce the concepts and offer a fundamental insight to vacuum technology, the principles involved, pumps and gauges used.
3. To provide the knowledge and methodology necessary to create and maintain vacuum.
4. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Vacuum technology to understand and solve real life problems.
2. Get knowledge of which pump to use to create vacuum.
3. Knowledge of which gauge to use for measuring vacuum.
4. Understanding of the course will create scientific temperament.

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Unit 1: Basics for Vacuum
Atmosphere and Vacuum, Gas pressure, Equations of ideal gas, Fundamental assumptions of kinetic theory of gas, Mean free path, Gas diffusion, Viscosity of gas, Thermal conductivity,
(7P, 8M)
Throughput and Speed, Different units of measurement of vacuum, Ranges of vacuum, Vacuum circuits: Impedance and Conductance, Mechanism of gas flow, pumping speed of vacuum pump.
(10P, 12M)

Unit 2: High vacuum pumps
Rotating vane type rotary pump: principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics. Oil diffusion vapour pump (single stage, multistage): principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics. **(8P, 12M)**

Unit 3: Ultrahigh vacuum pumps
Turbomolecular pump, Sorption pump, Ion pump, Cryogenic pump: principle, construction, working, ultimate pressure attainable. **(10P, 14M)**

Unit 4: Vacuum gauges
U-tube manometer, Mc-Leod gauge, Thermal conductivity gauges- Thermocouple gauge, Pirani gauge, Semiconductor gauge, Ionization gauges- Hot cathode and Cold cathode gauge, Bayard-Alpert gauge. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington
6. Handbook of Vacuum Technology: Karl Jousten
7. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.

Semester V: (DSE): Physics paper VI
PHY 506(D): Microprocessor-I
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Microprocessor to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Microprocessor.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Microprocessor to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit-1: Fundamentals of Microcomputer
Simple microcomputer architecture, Microcomputer operation, Address bus, Data bus, control bus, memory, Semiconductor and Magnetic memory, Cache memory, RAM and ROM, High level and Low level language, Assembler, Compiler and Interpreter. **(12P, 16M)**

Unit-2: Architecture of 8085 Microprocessor
The 8085 pin diagram and function of each pin, Microprocessor communication and bus timings, Demultiplexing the bus AD7- AD0, Microprocessor Architecture and function of each block. **(12P, 16M)**

Unit-3: Instruction Set of 8085 Microprocessor
Study of addressing mode for 8085:- Implied addressing, Register addressing, Immediate addressing, Direct addressing and Indirect addressing. Instruction set: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions, Stack/PUSH and POP instructions, I/O and Machine control instruction. **(15P, 20M)**

Unit-4: Stack and Subroutines
Stack, Subroutine, types of Subroutine and Macro **(06P, 08M)**

(Total: 45 Periods, 60 Marks)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, Dhanpat Rai& Sons, Delhi.
2. Microprocessor Fundamentals – Roger L. Tokheim.
3. 8085 Assembly Language Programing – L. A. Leventhal.
4. Microprocessor Architecture programming and Applications 8080 & 8085 – Ramesh Gaonkar.
5. 8086 Microprocessor programming and Interfacing – Gibson.
6. Advanced Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.
7. Microprocessors and Microcomputers- Soumitra Kumar Mandal.

Semester V: (DSE): Physics Paper VI
PHY 506 (E): Programming in C ++ - I
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamental Concept of Computer Programming language C++.

Course Objectives:
1. The course is designed to provide basic knowledge of C++ Programming.
2. C++ Programming is intended for software engineers, system analysts, program managers.
3. To learn how to design programs and applications using C ++.
4. To develop problem-solving skills and their implementation through C++ Programming.

Course Outcome: At the end of the course, the student will be able to
1. Explain basic principles of C ++ programming language
2. Concept of Variable, Operators, Control structure, Functions used in C++ programming.
3. Develop skills in writing a simple C++ program using a different statement.
4. Apply the best features of mathematics, engineering, and natural sciences to program real-life problems.

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Unit 1: Elements of C++ **[L: 04 M: 8]**
What is C++?, applications of C++, comments, I/O streams, the structure of the C++ program.

Unit 2: Variable and Expressions **[L: 08 M: 12]**
Variables, tokens, keywords, identifiers and constants, basic data types, user-defined data types & derived data types. Declaration and initialization of variables.

Unit 3: Operators in C++ **[L: 08 M: 14]**
Scope resolution operators, member dereferencing operator, memory management operators, manipulators, type cast operator, expressions and their types**.**

Unit 4: Control structure **[L: 10 M: 10]**
If, if-else, else-if, switch, break, continue.
Loop structures: while, do-while, for, nested for loop.

Unit 5: Functions in C++ **[L: 10 M: 10]**
Introduction, function prototyping, call by value & call by reference, Inline functions, reference arguments and default arguments. Math library functions.

Unit 6: Introduction to arrays, structures & union in C++ **[L: 05 M: 6]**
Definition, declaration, examples.

[Total: 45 Periods, 60 Marks]

References :

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

Semester V: (LAB): Physics paper VII
PHY 507: Physics practical -I
(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Perform any ten experiments:

1. Moment of Inertia by Bifilar suspension.
2. Y and η by Searl's method.
3. Y by Koenig's method.
4. Y by Newton's rings.
5. Searl's Goniometer.
6. Lloyd's single mirror.
7. To estimate temperature of Na flame.
8. Measurement of resistivity by four probe method.
9. Frequency of AC/ Tuning fork by stroboscope.
10. Variation of resistance of a filament of a bulb with its temperature.
11. Determination of velocity of sound using ultrasonic Interferometer.
12. Electromagnetic Pendulum.
13. Determination of circular aperture of LASER.
14. Measurement of self-inductance of a coil by Anderson's bridge.
15. To determine the human audibility.
16. Study of I-V characteristics of solar cell.
17. Determination of fill factor and efficiency of solar cell.
18. To determine the solar constant.

Semester V: (LAB): Physics paper VIII

PHY 508: Physics practical -II

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Group A: Perform any five experiments (Solid state physics, Electronics, Instrumentation):

1. Hall effect.
2. Analysis of XRD pattern.
3. Measurement of resistivity by two probe method.
4. Characteristics of JFET.
5. UJT characteristics.
6. UJT as relaxation oscillator.
7. Study of RC/LC filter(Low pass and High Pass)
8. Study of Heartly oscillator. (Calculation of frequency and verification of frequency from sinusoidal output waveform)
9. Measurement of self inductance using Maxwell's induction bridge.
10. Multiplexer (2 to 1 or 4 to 1) and/or De-multiplexer (1 to 2 or 1 to 4).

{For more knowledge and understanding, one can help the students to study, understand and use the VESTA software for determination of crystal structure on the basis of given data.}

Group B: Perform any five experiments from the following any one optional courses:

A) Technical Electronics:

1. To make two PCB's i) Using discrete components ii) Using IC components.
2. To study inverting and non inverting configuration of Op amp.
3. To study of OP AMP as an adder.
4. DAC (R- 2R ladder, without OP- AMP).
5. To study reverse bias characteristics of photodiode.
6. To study characteristics of photo transistor.
7. To design and study of regulated power supply using IC 723.
8. Designing and fabrication of transformer.
9. Triangular, square wave generator using OP AMP.
10. V to F converter using IC-741.
11. V to T converter using IC-741.
12. Study of function generator.
13. To study fixed voltage regulator using 78XX and 79XX.

{For more knowledge and understanding, one can help the students to study, understand and use the SKYLAB software to write and execute programs to study out put of inverting or non- inverting configuration of OPAMP, Opamp as adder or subtractor etc}

B) Refrigeration and Air conditioning:

1. Study of different tools used in Refrigeration and Air Conditioning.
2. To carry out the following operations on Copper tube i) Cutting ii) Bending iii) Flaring.

3. Study of hermetically sealed compressor used in refrigeration systems.
4. To carry out Swaging and Brazing of Copper tubes.
5. Study of thermostatic switch, LP/HP cut out switch and filters used in Refrigeration and A. C. systems.
6. Leakage testing and charging of a refrigeration system.

C) Vacuum technology:

1. To describe function of various parts of Rotary pump (with schematic diagram).
2. To describe the constructional details & working of vapour diffusion pump.
3. To measure the pumping speed of vacuum system by steady state method.
4. Study of McLeod gauge.
5. To calibrate & study the function of Pirani gauge.
6. To evacuate a system with a rotary pump (measurement of vacuum with & without ballast using McLeod gauge).

D) Microprocessor:

1. Diode matrix ROM.
2. Application of DAC (square/triangular sweep wave).
3. Up-down counter (4-bit).
4. Hexadecimal/decimal counter.
5. Multiplexer/Demultiplexer (using IC).
6. Study of shift register (using IC).
7. Shift an 8-bit and 16-bit number left by one bit.
8. One's and Two's Complement of number.

E) Programming in C++:

1. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to make addition, subtraction, multiplication & division
3. Write a C++ program to demonstrate the use of scope resolution operator
4. Write a C++ program to check whether given no. is palindrome or not
5. Write a C++ program to demonstrate the use of the inline function for finding a maximum of two numbers
6. Write a C++ program to accept array elements as positive and negative nos. & only print positive nos. as output (use continue statement) e.g. {10, -20, 3, 5,-7} O/P: {10,3,5}
7. Write a C++ program to generate Fibonacci series up to 20 terms e.g.
   1, 1, 2, 3, 5, 8,……… (20 terms)
8. Write a C++ program to create the following structure Roll-No. Stud-Name Class.
   Enter at least five records

Semester V: (LAB): Physics paper VII
PHY 509: Project -I
(Credits: 02): (60 L, 100M (40 Internal + 60 External))

ASSESSMENT OF PROJECT- FIRST TERM:

Student should submit a Progress Report on the work done by him/her during the First Phase of the project i.e. on the topics :

1. Project Selection
2. Literature Search Strategy
3. Literature Review
4. Project Planning.
5. Experimental work (30 to 40 %)

Instructions:

1. The topic of project of the first term must be continued in the second term.
2. The project report of first term should be maintained and should be produced to examiner of second term.
3. The student will have to give a seminar on the project topic in the practical exam.
4. The student must perform his project presentation by PPT on LCD projector.

Semester VI: (DSC): Physics paper I
PHY 601: Quantum Mechanics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Quantum Mechanics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Quantum Mechanics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Quantum Mechanics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: The Schrodinger Equation
Introduction to Quantum Mechanics, Wave function and its Physical interpretation, normalized and orthogonal wave functions, Requirements of wave function, Formulation of time dependent and time independent Schrödinger equation (Steady state equation), Probability current density and equation of continuity, Solution of Schrodinger's equations, Energy eigenvalues and eigenfunctions, Expectation value, Ehrenfest's theorem, Postulates of Quantum Mechanics. (Ref:1, 2 and 9)
(14P, 14M)

Unit 2: Applications of Schrödinger steady state equation
Particle in a one dimensional rigid box (derivation of energy eigenvalues and eigenfunctions), Step potential (Probability of reflection (R) and transmission (T)), Linear Simple Harmonic oscillator (derivation of energy eigenvalues and eigenfunctions) (1D). (Ref: 2,6 and 7) **(12P, 16M)**

Unit 3: Quantum theory of Hydrogen atom
Schrödinger equation in spherical polar co-ordinate system, Schrödinger equation for Hydrogen atom-separation of radial and angular part, Solutions of R,Θ,Φ equations, Significance of quantum numbers n, l, m_l and m_s. (Ref: 1). **(09P, 14M)**

Unit 4: Operators in Quantum Mechanics
Operators and linear operators, Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian), Commutator bracket, Commutator algebra, Commutator brackets using position, momentum and angular momentum operator, Commutation relations and Hamiltonian operator; Commutation rules for components of orbital angular momentum; Commutation relations of L^2 with components of orbital angular momentum; Commutation relation of components of orbital angular momentum with position operator, Ladder operators L_+, L_- Concept of parity, parity operator and its eigenvalues.(Ref: 2 and 4) **(10P, 16M)**

(Total: 45 Periods, 60 Marks)

References:
1. Perspectives of Modern physics : Arthur Beiser.
2. Advanced Quantum Mechanics: Satya Prakash, Kedarnath Ram Nath, Meerut
3. Quantum Mechanics: Gupta, Kumar, Sharma. Sultan Chand & Sons
4. Quantum Mechanics: Chatwal and Anand. Himalaya Publ. Co.
5. Quantum Mechanics: L.I.Schiff.
6. Quantum Mechanics: Powell and Crasemann, Addison-Wesley Pub. Co.
7. Introduction to Quantum Mechanics: D. Griffiths Published by Prentice Hall,
8. Quantum Physics: 2nd Ed. H.C. Verma, Surya Publications, Ghaziabad (UP), 2009.
9. Quantum Mechanics: Concepts and Applications, Nouredine Zettili, Wiley Publications.

Semester VI: (DSC): Physics paper II
PHY 602: Material Science
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Material Science to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Material Science.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….
1. Apply the concept of use of knowledge of Material Science to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Introduction to materials
Classification of materials
Properties of Materials: **Mechanical Properties**:. Interpretation of tensile stress – strain curve, Stress, strain (tensile, compressive and shear), strength, elasticity, plasticity, ductility, malleability, hardness, toughness, creep, fatigue, stiffness, Isotropy, Anisotropy, Deformation, Elastic and Plastic deformation, factor affecting the mechanical properties, **Thermal Properties**: Heat capacity, Thermal expansion, Thermal conductivity, **Electrical Properties**: Conductivity, resistivity, dielectric strength, piezoelectricity. **Optical Properties**: Wavelength spectrum of electromagnetic waves. Refraction, Reflection, absorption and Transmission of non-metallic materials. **(12P, 15M)**

Unit 2: Atomic disorder in materials
Solid solution: Types of solid solution - Substitutional and Interstitial solid solution, Hume Rothery Rules of solid solubility. **Imperfections or defects in solids**: (i) Point defects: vacancies, Frenkel defect, Schottky defect, (ii) Line defects (Dislocation): Edge dislocation, screw dislocation**,** (iii) Surface defects or interfacial defects and (iv)Volume defect. **Plastic deformation**: Mechanism by slip system. **(06P, 10M)**

Unit 3: Diffusion of solid material
Atomic diffusion- Introduction, Classification of Diffusion.
Diffusion mechanism – Vacancy mechanisms, Interstiitial mechanism, Direct interchange mechanism. Diffusivity, Self diffusion in nickel, Steady state Diffusion (Fick's first law of diffusion) and Non steady state Diffusions (Fick's second law of diffusion), variation of diffusivity with temperature ,Activation energy for diffusion, factor affecting the diffusion. **(09 P, 12M)**

Unit 4: Phase Diagram
Phase diagram, Phase equilibrium, Construction of phase diagram, Interpretation of phase diagram, Gibb's Phase rule, classification of phase diagram - Unary Phase diagram, Binary Phase Diagram, Binary Phase Diagram for: i) Sugar-Water, ii) NaCl-water, Eutectic reaction, lever rule, Sb-Bi phase diagram, Pb-Sn phase diagram**.** **(10 P, 13M)**

Unit 5: Organic Materials:
Polymers: Properties of polymer, Molecular weight, Molecular structure, **Types of Polymers**: Plastics and elastomers, Plastic: Thermoplast, Thermosets Polymerization, Mechanism of polymerization, Degree of polymerization, Addition Polymerization, Co-Polymerization, and Condensation Polymerization. **(08P, 10M)**

(Total: Periods 45, Marks 60)

References:
1. Materials Science & Engineering: An Introduction (6th Edition): William D. Callister
2. Elements of Materials Science & Engineering: Van Vlack
3. First Course in Materials Science & Engineering: V Raghavan.
4. Material Science: S. L. Kakani, Amit Kakani. New Age International Publishers.
5. Material Science : G.K.Narula and K.S.Narula, Tata McGraw Hill.
6. Material Science and Processes : S.K.Hajra – Chaudhari, Indian Book Distributing company.

Semester VI: (DSC): Physics paper III
PHY 603: Nuclear Physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Nuclear Physics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Nuclear Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Nuclear Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Nucleus and Nuclear Forces
Nuclear compositions:- Constituents, charge, size, density, atomic mass of nucleus, nuclear magnetic moment, concept of parity(even and odd), classification of nuclei, mass defect and binding energy, stability of nuclei, packing fraction, Problems. Nuclear forces: Nuclear force, features of nuclear forces, saturation and short range nuclear forces, charge symmetry and charge independence, spin dependence of nuclear force, Meson exchange theory of nuclear forces, Elementary particles (List only). **(9L, 12M)**

Unit 2: Radioactivity
Introduction, Law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, Applications of radioactivity (Agricultural, Biological, Medical and industrial), Problems. **(06L, 08M)**

Unit 3: Nuclear Models
Types of nuclear models (List only), Single particle shell model**:** Introduction, Assumptions, Evidence of shell model, Theory of nuclear shell potential, nuclear spin and parities, limitations of shell model. Liquid drop model**:** Introduction, assumptions, semi-empirical mass formula. Limitations of Liquid drop model, Problems**.** **(07L, 09M)**

Unit 4: Nuclear Reactions
Introduction, Theories of nuclear reactions, conservation laws, Q-value equation, Energetic of exoergic reactions, Energetic of endoergic reactions, Threshold energy, Problems. **(07L, 09M)**

Unit 5: Nuclear Energy
Introduction, Nuclear fission, Explanation on the basis of liquid drop model, energy available from fission:- Estimation of energy from masses of fission fragments and from binding energy, Nuclear chain reaction, Nuclear Fusion, Nuclear Reactor: Basic principle, classification, constituents parts, Heterogeneous reactor, Swimming pool reactor, Power reactor, Problems. **(10L, 14M)**

Unit 6: Nuclear Detectors and Accelerators
Types of detectors, Geiger-Mueller counter, Scintillation counter, Classification of accelerators**:** Cyclotron and Betatron. **(06L, 08M)**

(Total: 45 Lectures, 60 Marks)

References:

1. The atomic Nucleus: R D Evans, McGraw Hill Book Company.
2. Nuclear Physics: D C Tayal, Himalaya Publishing House, Bombay.
3. Nuclear Physics: Irving Kaplan, Narosa Publishing House, New Delhi.
4. Basic Nuclear Physics and Cosmic Rays: B N Srivastava, Pragati Prakashan, Meerut.
5. Concepts of Modern Physics – Arthur Beiser (5th Edition).
6. Atomic Physics: J.B. Rajam.
7. Introduction to Nuclear Physics: H.A. Enge (Addition Wesely Co.)

Semester VI: (DSC): Physics paper IV
PHY 604: Modern and Applied Physics
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Modern and Applied Physics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Modern and Applied Physics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Modern and Applied Physics to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Plank's Quantum theory:
Planck's quantum theory, properties of photon, Planck's constant and light as a collection of photons; photo-electric effect and Compton effect, Experimental verification of Compton's effect. **(04 P, 06 M)**
Unit 2: Bohr's and Sommerfield theories of hydrogen atom
Introduction of atomic spectra, Inadequacy of classical planetary model of hydrogen atom, Bohr's theory of hydrogen atom, Extension of Bohr's theory, Experimental verification of discrete atomic energy levels, correspondence principle, Bohr's Sommerfield model and relativistic effects, Limitations of quantum mechanical model. **(09 P, 12 M)**
Unit 3: Matter Waves (Foundation of Quantum mechanics)
Need of quantum mechanics, Wave particle duality of matter, de-Broglie hypothesis, Expression for matter waves, Electron diffraction , Davission and Germer experiment, concept of wave group , phase velocity, group velocity, particle velocity and relations between them, Uncertainty principle, Thought experiment (Gamma ray microscope), different forms of uncertainty principle, applications of uncertainty principle (Non existence of electron in nucleus, determination of ground state of electron and size of hydrogen atom). (**09 P, 12 M**)
Unit 4: Fiber Optics
Introduction, construction of optical fiber, principle of operation, concept of acceptance angle, numerical aperture, attenuation in optical fiber and attenuation limit, preparation of optical fiber, optical fiber materials, types of optical fiber Single mode and multimode fibers, advantages and disadvantage of optical fiber, communication, Applications of fiber optics, Detail discussions on following applications: Temperature sensor, displacement sensor, fiber optic endoscopy, fiber optic communications.
(07P, 09 M)
Unit 5: Holography and its application
Concept of monochromatic and coherent source, basic idea of hologram, construction and re-construction hologram, types of hologram (list only), application of holography in microscopy and character recognition. **(07P, 09 M)**
Unit 6: Introduction to bioelectricity
Electricity observed in living systems, examples and origin of bioelectricity, sodium and potassium transport, Nernst equation, resting and action potential, conduction velocity. **(09 P, 12 M)**
Total: (45 Periods, 60 Marks)

References

1. Concepts of Modern Physics: S. L. Gupta, S. Gupta, Third Edition-1989, Publisher: Dhanpat Rai and Son's.
2. Modern Engineering Physics: A. S. Vasudevan, Publisher: S Chand.
3. Physics for Engineers: M.R. Srinivasan, Publisher: New Age International.

4. REFRESHER COURSE IN PHYSICS, VOLUME-II, C. L. Arora, Publisher: C. Chand and Company Ltd., New Delhi.
5. Modern Physics – B. L. Theraja, Publisher: C. Chand and Company Ltd., New Delhi.
6. Elementary Modern Physics - Atam P. Arya, Publisher: Addison Wesley Longman Publishing Co., New edition
7. An Introduction to Lasers -Theory and Applications - M. N. Avadhanalu, Publisher: C. Chand and Company Ltd., New Delhi.
8. Introduction to Fiber Optics: Ajoy Ghatak, K. Thyagarajan, Publisher: Cambridge University Press, 1998.
9. From Neuron to brain - Kuffer & Nicholas, Publisher: Sinauer Associates is an imprint of Oxford University Press; 5 edition (2011).
10. Biomedical Instrumentation and Measurements (II Edition) - L. Cromwell, F. J. Weibell, E. A. Pfeiffer (Pearson Education Singapore Pvt. Ltd.).

Semester VI: (SEC): Physics paper V
PHY 605: Basic Instrumentation Skills
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Basic Instrumentation skills to Under Graduate students.

Course objectives:
1. To impart knowledge of basic concepts in Basic Instrumentation skills.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….
1. Handle and use various basic mechanical and electrical measuring instruments
2. Understanding of the course will create scientific temperament.

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(This course is to get exposure with various aspects of instruments and their usage throughhands-on mode. Experiments listed below are to be done in continuation of the topics.)

Unit 1. Use of basic measuring instruments:
Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Study of Vernier calliper, Screw gauge, travelling microscope and their utility to measure the dimension of a solid block, volume of cylindrical objects, diameter of a thin wire and capillary tube, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

(04 P, 06M)

Unit 2. Electrical quantity measuring instruments:
PMMC, Voltmeter (D.C. and A.C), specifications and their significance. Ammeter (D.C. and A.C), specifications and their significance. Ohmmeter (Series and Shunt type), specifications and their significance. Multimeter, Steps of measurement of dc voltage and dc current, ac voltage, ac current and resistance using multimeter, Specifications of a multimeter and their significance. **(12 P, 14M)**

Unit 3: Cathode Ray Oscilloscope
Block diagram of basic CRO, Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence and chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance, Use of CRO for the measurement of voltage (dc and ac), frequency, time period and phase. Introduction of Dual trace CRO and digital oscilloscope, probes. **(12P, 14M)**

Unit 4: Signal Generators and Analysis Instruments
Block diagram, explanation and specifications of low frequency signal generators, pulse generator, and function generator. Brief idea for testing, specifications. **(07P, 10M)**

Unit 5: Digital Instruments
Principle and working of digital meters. Comparison of analog and digital instruments. Characteristics of a digital meter. Block diagram and Working principle of digital voltmeter (Ramp type only). Block diagram and working of a digital multimeter, Digital Frequency meter: Block diagram and Working principle: frequency and period measurement, accuracy and resolution.

(10P, 16M)

Total: (45 Periods, 60 Marks)

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The test of lab skills will be of the following test items:
1. Use of an oscilloscope.

2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter for measuring voltages
5. Trouble shooting a circuit

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. Measurement of voltage, frequency, time period and phase angle of a wave using CRO.
4. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times of a wave using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

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Reference Books:

1. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi.
2. Basic Electronics (Solid State): B.L. Thereja, Publisher: S. Chand and Company, New Delhi.
3. Electrical measurements and measuring instruments: R K Rajput, S. Chand and Co. New Delhi.
4. Digital Principles and Applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Modern Electronic Instruments and Measurement techniques: Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
6. A course in Electrical and Electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
7. Digital electronics, R P Jain
8. Basic Electronics: B. Grob, Publisher: McGraw Hill Book Co. New York,
9. Electronic Instrumentation: H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.
10. Digital instrumentation by A J Bouwens
11. A text book in Electrical Technology - B L Theraja – S. Chand and Co.
12. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
13. Logic circuit design, Shimon P. Vingron, 2012, Springer.
14. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
15. Electronic Devices and circuits, S. Salivahanan and N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
16. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
17. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Semester VI: (DSE): Physics paper VI
PHY 606(A): Technical Electronics II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Technical Electronics to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Technical Electronics.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept of use of knowledge of Technical Electronics to real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Sound System

Microphones: characteristics, types (list only), carbon microphone and dynamic type microphone (Principle, construction and working), Loud speakers: Characteristics, Dynamic (Moving coil type) speaker, Multiway speaker system (woofer and tweeter), Connection type of speakers (series, parallel and series-parallel type). [R1, R2, R9]. **(08P, 12M)**

Unit 2: Public Address System

Block diagram of Public Address (P.A.) system and its explanation, requirements of P. A. system, typical P.A. Installation planning (Auditorium having large capacity, college sports), Volume control, Tone control and Mixer system, Concept of Hi –Fi system, Monophony, Stereophony, Quadra phony, Dolby A and Dolby B system, CD- Player: Block diagram of CD player and function of each block. [R1, R2, R9].

(10P, 14M)

Unit 3: Medical instruments.

Biopotential, Types of electrodes, ECG (principle, block diagram, features) Ultrasonography: working principle [R 3, 4, 5] **(07P, 8M)**

Unit 4: Transducer

Definition, Classification, Selection of transducer, Electrical transducer: Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT, Peizo-electric Transducer, Optoelectronic transducers: LDR, Chemical sensors: pH sensor, Gas sensor (Fundamental aspects), Humidity sensor (Resistive). [R7, R8]. **(10P, 14M)**

Unit 5: Modern appliances

Remote Control: Operating principle, block diagram, features.
Microwave Oven: Operating principle, block diagram, features.
Cellular Phone: Operating principle, Block diagram, specifications, features, and functions performed.
Washing Machine: Operating principle, block diagram, features, Fuzzy Logic (Idea only),
Electronic Weighing Systems: Operating principle, Block diagram, features. [R8].
Infrared Thermometer: Operating principle, Block diagram, features. **(10P, 14M)**

(Total: 45 Periods, 60 Marks)

References:

1. Audio and Video Engineering System: R.G. Gupta, Tata Mc-GrawHill Publishing Company Ltd, New Delhi.
2. Basic Electronics: B. L. Thereja, S. Chand Publications, New Delhi.

3. Introduction to Bio-medical Electronics: Joseph-Du-bary, Tata Mc-Graw Hill Publishing Company Ltd, New Delhi.
4. Medical instrumentation Application and design: J. C. Wobster
5. Biomedical instruments and measurements: L. Cromwell, F. J. Weibell, Printice Hall of India of India Pvt. Ltd, New Delhi.
6. Transducers and display systems: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Solid state Gas sensors- edited by P. T. Moseley and B.C. Tofeld, Harwell, Adam Hilger and Philadelphia
8. Measurement and Instrumentation Principles: Alan S. Morris, Butterworth-Heinemann.
9. Consumer Electronics: J.S. Chintode, Technical Publication, Pune.

Semester VI: (DSE): Physics paper VI
PHY 606(B): Refrigeration and Air conditioning II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Refrigeration and air conditioning to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Refrigeration and air conditioning.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Refrigeration and air conditioning to understand and solve the real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Psychrometry:
Introduction, Meaning of air conditioning, Five main factors of comfort air conditioning, Psychrometry and psychrometic properties, psychrometic relations: Dalton's law of partial pressure; relation between partial pressure & specific humidity; relation between degree of saturation & relative humidity, Types of psychrometers, Psychrometic processes, Bypass factor and its relation, Summer air conditioning systems for Hot & Dry; Hot & Humid out door conditions, Summer air conditioning with evaporative cooling, Winter air conditioning system for mild cold weather. (Ref. 1: Chapter -16) **(12L, 16M)**
Unit 2: Cooling load calculations & design of air conditioning systems:
Different heat sources, Heat flow due to conduction, Sun load, Occupants load, Equipment load, Infiltration load, Miscellaneous heat sources, Design aspects of air conditioning system, Cooling load and air quantities. (Ref. 1: Chapter -19) **(7L, 10M)**
Unit 3: Air Conditioning equipments:
Air cleaning and Air Filters: Functions, Types, Wet filters, Electronic filters, and Centrifugal dust collector. Cooling Coils: Bypass factor of multidepth coils. Humidifiers: Functions, Atomization type humidifiers, Impact type humidifiers, Pan & coil type humidifiers. Dehumidifiers: Functions, Refrigeration humidifiers, Spray type humidifiers, De-humidifying air washers. Fans and Blowers: Functions, Axial flow fans, Centrifugal fans. Grills and Registers. (Ref. 1: Chapter -25) **(10L, 14M)**
Unit 4: Air Conditioning Control systems:
Basic elements of control systems, Temperature control elements: Bimetal type thermostat, Sealed bellow type thermostat, Electrical resistance and thermocouple type thermostat. Humidity Control Elements: Hair type humidistat, Absorption type thermostat, Water vapour recorder. Actuators: Relays Introduction to Transmission systems:Pre heat and humidification control systems, Cooling dehumidification and reheat control system, Face and bypass control system. (Ref. 1: Chapter -26) **(10L, 12M)**
Unit 5: Solar Refrigeration System
Vapour Compression Refrigeration system using solar energy, Vapour absorption refrigeration system using solar energy, Solar refrigeration using a solid absorption cycle, Solar refrigerators sing Photovoltaic panels, (Ref.1: Chapter -28) **(6L, 8M)**
(Total: 45 Periods, 60 Marks)

Reference Books:
1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar.Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd
3. Principles of Refrigeration: Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition

Semester VI: (DSE): Physics paper VI
PHY 606(C): Vacuum Technology-II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Vacuum technology to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Vacuum technology.
2. The course should prepare the student for operating, simulating and construction of vacuum systems.
3. The course also involves the related experiments based on the theory.

Course outcome:
Learner will be able to ….
1. Apply important laws of physics which govern how a vacuum system works.
2. Account for which components are used in a vacuum system, their construction, function and use.
3. Account for troubleshooting a vacuum system.
4. Run simulations and write a specification for a simple vacuum system.

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Unit 1: Vacuum materials and components
Adsorption, Absorption, Desorption. Diffusion and penetration of gases through solid surfaces, Vapour pressure of different materials, Outgassing of materials, Desired properties of materials used for fabrication of vacuum system. **(7P, 8M)**
(i) Vaccum Seals: (a) Permanent seals- Welding, Brazing, Soldering (b) Demountable seals- Waxes, Resins and Adhesives, Gaskets seal: Elastomer, metal. Feedthroughs: Electrical Feedthroughs, Motion Feedthroughs: Wilson seal, Bellows seal. **(8P, 11M)**
(ii) Valves: (a) Roughing and For-line valves: Disk valve, Ball valve. (b) High vacuum valves: Gate valve, disk valve, flap valve, Butter-fly valve. (c) Gas admittance valves: disk valve, Needle valve.
(8P, 11M)

Unit 2: Leak detection
Real and Virtual leaks, Leak detection method: (a) Over pressure method- Bubble method, Halide torch, Sniffer technique. (b) Low pressure method- Blocking (sealing) method, Tesla coil, Halogen leak detector, Organic vapour and gas probe with suitable pressure gauge as detector. **(11P, 14M)**

Unit 3: Vacuum system fabrication
General consideration of designing, Construction of High vacuum system (Combination of Rotary and Oil diffusion pump), Its operational procedure, Construction of Ultrahigh vacuum system and its operational procedure. **(8P, 11M)**

Unit 4: Application of Vacuum Technology
Applications of Vacuum technology in Research and Industry. **(3P, 5M)**

(Total: 45 Periods, 60 Marks)

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington
6. Handbook of Vacuum Technology: Karl Jousten
7. Vacuum Physics and Techniques, T. A. Delchar, Chapman and Hall.

Semester VI: (DSE): Physics paper VI
PHY 606(D): Microprocessor- II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the fundamentals of Microprocessor to Under Graduate students.
Course objectives:
1. To impart knowledge of basic concepts in Microprocessor.
2. To provide the knowledge and methodology necessary for solving problems in Physics.
3. The course also involves the related experiments based on the theory.
Course outcome:
Learner will be able to ….
1. Apply the concept and use of knowledge of Microprocessor to understand and to solve real life problems.
2. Understanding of the course will create scientific temperament.

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Unit 1: Assembly Language Programming
Masking of 4- MSB and LSB of given number, One's and two's complement of 16- bit numbers, Shift 16- bit numbers left by one bit, 8- bit addition, 8- bit subtraction, Decimal addition and decimal subtraction of two 8 bit numbers, 8- bit multiplication, Find largest and smallest numbers from a series of given number, Find square root of given number from Look up table. Code conversion programs:-Hex to ASC II conversion, BCD to binary conversion, Decimal to seven segment conversion. **(15P, 20M)**

Unit 2: Interfacing of Memory and Peripheral Devices
Introduction, Interfacing with RAMS & ROMS, I/O interfacing basics, Interfacing with practical I/O memory mapped I/O and I/O mapped I/O schemes, Direct Memory Access (DMA). Data transfer.
(09P, 12M)

Unit 3: Programming Peripheral Interface (PPI)
Architecture of Intel-8255, Pin diagram of Intel-8255, Functions of each pin, Control word format, Operations of Mode-0, Mode-1 & Mode-2**.,** Single-Bit Set/Reset (BSR) Mode and Applications of 8255 PPI (list only) . **(10P, 13M)**

Unit 4: Programming Communication Interface and Counter/Interval Timer
Architecture of Intel-8251, Pin diagram of Intel 8251, Functions of each pin, Mode word format, Control word format, Status word format, Architecture of Intel-8253, pin diagram of Intel-8253, Functions of each pin, Operations of Mode-0, Mode-1, Mode-2, Mode-3, Mode- 4 and Mode-5.
(11P, 15M)
(Total: 45 Periods, 60 Marks)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, DhanpatRai& Sons, Delhi.
2. Microprocessor Fundamentals – Roger L. Tokheim.
3. 8085 Assembly Language Programing – L. A. Leventhal.
4. Microprocessor Architecture programming and Applications 8080 & 8085 – Ramesh Gaonkar.
5. 8086 Microprocessor programming and Interfacing – Gibson.
6. Advanced Microprocessor and peripherals (Architecture, programming and interfacing) **–** A. K. Ray, K. M. Bhurchandi.
7. Microprocessors and Microcomputers- Soumitra Kumar Mandal.

Semester VI: (DSE): Physics paper VI
PHY 606 (E): Programming in C+ + - II
(Credits: 03) :(45 Lectures 60 Marks)

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Course description:
This course is aimed at introducing the object-oriented concept Programming language C++.
Course Objectives:

- To learn Object-Oriented Design with C++ Programming
- Ability to write a computer program to solve a specific program
- To handle abnormal termination of a program using exception handling

Course Outcomes:

1. Acquire knowledge of Object and Class.
2. Explore polymorphism using function overloading and operator overloading.
3. Understand the different aspects of the hierarchy of classes and their extensibility
4. Understands the concept of Virtual function, streams, and files, Generic Programming.
5. Write programs for handling run time errors using exceptions

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Unit 1: Objects & Classes **[L: 06 M: 08]**
Simple classes (class specification, C++ objects, accessing class members), constructors and destructors, constant member functions.

Unit 2: Functions and operator overloading **[L: 10 M: 12]**
Overloading functions, introduction to operating overloading, overloading unary and binary operators, overloading arithmetic assignment operator.

Unit 3: Inheritance **[L: 10 M: 10]**
Derived class and base class, derived class constructors, public and private inheritance, multiple inheritances, hierarchical inheritance, multilevel inheritance, containership (classes within classes).

Unit 4: Virtual functions **[L: 06 M: 10]**
Virtual functions, pure virtual functions, friend functions, Static functions, copy constructor, this pointer.

Unit 5: Generic programming **[L: 05 M: 10]**
Introduction to a template, function within a template, introduction to exceptional handling.

Unit 6: File and streams **[L: 08 M: 10]**
Input/Output streams, classes for steam operation, opening and closing files, file pointers and their manipulations, error handling during file operations.

(Total: 45 Periods, 60 Marks)

References:

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

Semester VI: (LAB): Physics paper VII

PHY 607: Physics practical -I

(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Perform any TEN experiments:

1. Surface tension by Quinke's method.
2. Surface tension by soap bubble method.
3. Characteristics of G.M. counter.
4. Diffraction by straight edge/cylindrical obstacle.
5. e/m using Thomson's method.
6. Viscosity by rotating cylinder method.
7. Determination of 'g' by conical pendulum.
8. Study of oscillatory charge and discharge through an inductance and resistance.
9. To determine value of Boltzmann Constant using V-I characteristics of PN diode.
10. To determine work function of material of cathode using photocell.
11. To determine value of Plank's constant using LEDS of at least four different colours.
12. To study intensity response of photocell and verify inverse square law of radiations.
13. To measure the numerical aperature of an optical fiber.
14. Study of bending loss in optical fiber.
15. Study of I-V characteristics of photocell.
16. Determination of Plank's constant of Photocell.
17. Study of Solar still for water distillation.
18. Study of box type Solar cooker.

Semester VI: (LAB): Physics paper VIII
PHY 608: Physics practical -II
(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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Group A: Perform any Five experiments (Material Science, Electronics, Instrumentation):

1. Determination of curie temperature of Ferrite.
2. Determination of specific heat of graphite at different temperature
3. To study characteristics of thermisters.
4. Determination of thermoelectric power.
5. Study of Astable Multivibrator using IC 555.
6. Binary weighted DAC (R-2R ladder) using OP-AMP.
7. Determination of Core losses in transformers.
8. To study of clocked RS flip flop using NAND gates.
9. Study of IC 7490 as mod 2, mod 5 and mod 10 counter.
10. To study RC coupled Single stage transistor amplifier. (Voltage gain , Frequency response)

Group B: Perform any Five experiments from the following optional courses:

A) Technical Electronics:

1. To study characteristics of LDR.
2. Study of P. A. system (series and parallel connection of two speakers) and measurement of equivalence resistance.
3. Use of C.R.O as a measurement tool for different electrical parameters (frequency, a. c./d. c. voltage, pulse height, pulse width, rise time and fall time).
4. Use of thermocouple for measurement of temperature.
5. Study of OP AMP as substractor.
6. Study of OP- AMP as a differentiator.
7. Study of OP- AMP as an integrator.
8. Displacement measurement using LVDT.
9. Frequency response of loudspeaker (twitter, woofer, mid-range).
10. Study of E.C.G .
11. Thermister as a thermometer using IC 741.
12. Half wave precision rectifier using OP AMP.
13. Full wave precision rectifier using OP AMP.

B) Refrigeration and Air conditioning:

1. To find the COP of a domestic refrigeration system.
2. Detection of trouble/faults in a refrigerator and window air conditioner.
3. Dismantling of Window type A.C. and testing after assembly.
4. Visit to a cold storage plant.
5. Visit to a centrally air conditioned building.
6. Visit to a Ice plant.

C) Vacuum technology:

1. To measure the pumping speed of vacuum system (use of Gaedes equation).
2. Demonstration of oil diffusion pump & to evacuate the system & to measure the ultimate vacuum.
3. To study the effects of conductance of pumping speed of oil diffusion pumping module.
4. Deposition of metallic thin film.
5. To investigate the variation of pumping speed of vapour diffusion pumping module with the pressure in vacuum system.
6. Pumping speed measurements using the constant volume method.

D) Microprocessor:

1. Find square root/square of number using look up table.
2. 8-bit decimal addition/subtraction.
3. Find largest/smallest number from series of 8-bit numbers.
4. Conversion of Hexadecimal to ASCII code.
5. 8-bit binary multiplication.
6. LED interface (Time delay generation).
7. Interfacing of thumbwheel switch.
8. Conversion of 8-bit Hexadecimal number to binary number.

E) Programming in C++:

1. Write a C++ program to implement string operations i) strlen ( ) ii) strcat ( ) as class members. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to swap two integers, two floats and two-character variables using function overloading.
3. Write a C++ program to demonstrate the use of constructors and destructors.
4. Write a C++ program to overload + operator to add two complex nos.
5. Write a C++ program to implement hierarchical inheritance.
6. Write a C++ program to implement multiple inheritances.
7. Write a C++ program to implement virtual functions.
8. Write a C++ program to demonstrate the use of function templates

Semester VI: (LAB): Physics paper VIII
PHY 609: Project II
(Credits: 02): (60 L, 100M (40 Internal + 60 External))

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ASSESSMENT OF PROJECT- SECOND TERM:

Student should submit a Final Project Report on the work done by him/her during the First and Second Phase of the Project i.e. on the topics:

1. Experimental work. (remaining further work in continuation with the work in the first term)
2. Characterize the samples, if any.
3. Discussion of the results.
4. Conclusions.

Instructions:

1. The topic of project of the first term must be continued in the second term.
2. The project report of first term should be maintained and should be produced to examiner of second term.
3. The student will have to give a seminar on the project topic in the practical exam.
4. The student must perform his project presentation by PPT on LCD projector.

CAREER OPPORTUNITIES FOR B. Sc. PHYSICS STUDENTS

B.Sc. Physics students can find jobs in public as well as in private sectors. There are many opportunities available for B. Sc Physics students in technical as well as scientific fields. They can work as Science and Mathematics Teachers, Quality Control Manager, Laboratory assistant, Laboratory Technician, School Science Technician in any government or private organization.

Private Sector:

There are many opportunities available in IT field for B. Sc (Physics) graduates. Many IT companies such as Infosys, Wipro and TCS are recruiting B. Sc. Physics graduates for software jobs. They can also get jobs in Energy Plants. Another jobs available for these graduates is Technician in Electronic Industry. They can apply for jobs in many companies in automobile industry. Some of those companies are Maruti Udyog, TATA Motors and Tech Mahindra. The B. Sc. (Physics) graduates can apply and secure their job in Solar devices production industries, electrical or electronic industries with their skills developed while syudying.

Government Sector:

There are vast opportunities available for B. Sc graduates in Government sector. They can apply for jobs in Scientific Research and Development Organizations such as The Defense Research and Development Organization (DRDO), CSIR, Physical Research Laboratory (PRL) Ahmedabad, Saha Institute of Nuclear Physics Kolkata and Nuclear Science Centre New Delhi. They can also apply for various jobs in popular government organizations such as Bhabha Atomic Research Centre (BARC), Atomic Energy Regulatory Board (AERB), Oil and Natural Gas Corporation (ONGC), Bharat Heavy Electricals Limited (BHEL), National Thermal Power Corporation (NTPC).

They can also apply for the various competitive exams conducted by Union Public Service Commission such as IFS, IPS and IAS. Several other government exams conducted for recruiting B. Sc Physics graduates are Tax Assistant Exam, Statistical Investigator Exam, Combined Graduate Level Exam.

Another option available for B. Sc Physics graduate is to apply for jobs in public sector banking. Several banks are conducting exam every year for recruiting graduates to the post of Probationary Officers. They can also find many jobs in Railway sector. They should qualify the exams conducted by Railway Recruitment Board to get a job in Railway sector. These graduates can also apply for Combined Defense Services Exams conducted for recruiting candidates to various posts in Defense Department.

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

Syllabus

T.Y.B.Sc.

Subject: Chemistry

Choice Based Credit System

With Effect from June -2020

As Per U.G.C. Guidelines

Prepared By

Board of Studies

Chemistry,

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

Syllabus

Class- T.Y.B.Sc.   Subject- Chemistry

Choice Based Credit System (CBCS) (60-40) Pattern

with effect from June-2020

Structure of Curriculum of T.Y.B.Sc. (Chemistry)

Semester – V

Course Type	Course code	Course Title	Credits	Hours per week	Teaching Hours
Core I	CH – 501	Principles of Physical Chemistry-I	3	3	45
Core II	CH – 502	Inorganic Chemistry	3	3	45
Core III	CH – 503	Organic Reaction Mechanism	3	3	45
Core IV	CH – 504	Industrial Chemistry	3	3	45
Skill Enhancement (SEC)	CH – 505	Analytical Instrumentation	3	3	45
Elective **(Any One)**	CH – 506 (A)	Biochemistry	3	3	45
	CH – 506 (B)	Green Chemistry	3	3	45
Core course **(Practical)**	CH – 507	Physical Chemistry Practical	2	4 (Per Batch)	60
	CH – 508	Inorganic Chemistry Practical	2	4 (Per Batch)	60
	CH – 509	Organic Chemistry Practical	2	4 (Per Batch)	60
Non-Credit Audit Course **(Any One)**	AC-510	NSS	No Credit	2- Batches	60
	AC-511	NCC		2- Batches	60
	AC-512	Sports		2- Batches	60

Note:

1. Each lecture is of one hour (60 Minutes) duration.
2. Each theory paper has three lectures per week.
3. Each practical course has four lectures per week.
4. An industrial study tour is compulsory for the T.Y.B.Sc. Students. The students should submit their tour reports at the time of practical examination of VI^{th} Semester.

5. Use of Chart/Text book/Hand book of practical is allowed during examination.
6. Scientific calculator (non-programmable) is allowed during theory and practical examination.
7. All units should be in SI unit.

Semester VI

Course Type	Course code	Course Title	Credits	Hours per week	Teaching Hours
Core I	CH – 601	Principles of Physical Chemistry-II	3	3	45
Core II	CH – 602	Chemistry of Inorganic Solids	3	3	45
Core III	CH – 603	Spectroscopic Methods of Structure Determination	3	3	45
Core IV	CH – 604	Chemistry of Industrially Important Products	3	3	45
Skill Enhancement	CH – 605	Analytical Techniques	3	3	45
Elective **(Any One)**	CH – 606 (A)	Polymer Chemistry	3	3	45
	CH – 606 (B)	Research Methodology for Chemistry	3	3	45
Core course **(Practical)**	CH – 607	Physical Chemistry Practical	2	4 (Per Batch)	60
	CH – 608	Inorganic Chemistry Practical	2	4 (Per Batch)	60
	CH – 609	Organic Chemistry Practical	2	4 (Per Batch)	60
Non-Credit Audit Course **(Any One)**	AC-610	Soft Skill	No Credit	2- Batches	60
	AC-611	Yoga		2- Batches	60
	AC-612	Practicing Cleanliness		2- Batches	60

Note:

1. Each lecture is of one hour (60 Minutes) duration.
2. Each theory paper has three lectures per week.
3. Each practical course has four lectures per week.

4. An industrial study tour is compulsory for the T.Y.B.Sc. Students. The students should submit their tour reports at the time of practical examination of VI Semester.
5. Use of Chart/Text book/Hand book of practical is allowed during examination.
6. Scientific calculator (non-programmable) is allowed during theory and practical examination.
7. Values required for spectral problems should be provided in the question paper.
8. All units should be in SI unit.

Chairman B.O.S. **Dean Science Faculty**

Aims and Objectives

To enable the students-

- To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry.
- To make students capable of studying Chemistry in academic and Industrial courses.
- To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
- To develop problem solving skills in students.
- To expose the students to different processes used in Industries and their applications.
- To develop ability and to acquire the knowledge of terms, facts, concepts, processes, techniques and principles of subjects,
- To develop ability to apply the knowledge of contents of principles of chemistry.
- To inquire of new knowledge of chemistry and developments therein.
- To expose and to develop interest in the fields of chemistry
- To develop proper aptitude towards the subjects.
- To develop the power of appreciations, the achievements in Chemistry and role in nature and society.
- To develop skills required in chemistry such as the proper handling of apparatus and chemicals.

NOTE:

1. There are in all Six theory courses (4 Core courses, 1 Skill Enhancement course, 1 Elective) and Three practical (Core course practical) courses for each semester.
2. Each theory paper carry 100 Marks out of which 40 Marks are allotted for internal assessment and 60 Marks for external assessment.

3. As per the directions given by University, at the end of each semester internal examination will be conducted for 40 marks and University Examination will be conducted for 60 Marks.
4. The student has a right to choose any one of the optional paper for Vth semester either CH-506 (A) OR CH-506 (B), Similarly The students has a right to choose any one of the optional paper for VIth semester either CH – 606 (A) OR CH – 606 (B).
5. A student is expected to submit a journal certified by the Head of the Department/Head of the Institution for each semester.
6. A student will not be permitted to appear for the practical examination unless he/she produce a certified journal. If the journal is lost, the student should produce a certificate from Head of the department / Head of the Institution stating that he/she has satisfactorily completed the practical work.
7. Industrial tour is compulsory for all the students.

Rules for Personal Safety in Chemistry Laboratory:

- A long sleeved, knee length laboratory coat/ apron is recommended. Long pants and closed toed shoes must be worn for individual safety. Loose clothing, open style shoes and sandals are prohibited. Long hair must be tied up. Each student will have to get his / her own necessary protection items.
- For eye protection, safety goggles must be worn in the laboratory whenever necessary. If the student wears contact lenses, full protection goggles, which provide total seal around eyes, must be worn. All students are expected to wear safety goggles.
- Prior to the practical examination, the teacher-in-charge will check all protective equipment to ensure that they are in order.
- Pipetting by mouth should be avoided. Use of pro-pipette bulbs is recommended.
    - All laboratories should be equipped with safety chart, adequate first aid requirements and fire extinguishers.

Kavayitri Bahinabai Chaudhari

North Maharashtra University, Jalgaon

T.Y.B.Sc Chemistry Syllabus

(CBCS) Pattern

Semester V **Core Course I**

CH-501

Subject- Principles of Physical Chemistry-I

(Theory: Lectures = 45 hrs. Marks 60) **(Credits: 03)**

Course objectives

- To orient and acquaint the students towards the basic concepts of Quantum Chemistry
- To acquire knowledge about rates of chemical reactions and distinguishing the reaction of different order and their characteristics.
- To understand the basic principles of phase rules and phase diagrams.
- To learn the underlying principles of electrode reactions, electrochemical cells and applications of EMF.

Learning outcomes

After successful completion of this course, students are expected to:

- Understand the significance of wave function and postulates of quantum mechanics.
- Deduce rate equations and half-life equations for first and second order reactions
- Draw and explain the one and two component system phase diagrams.
- Explain the principles of electrode processes and apply them during Practicals.

UNIT-1. Basic Quantum Chemistry **(L-11, M-15)**

Failures of Classical Mechanics, Origin of quantum mechanics, Particle aspect of radiation: Blackbody radiation, Photoelectric effect, Compton Effect, de Broglie's hypothesis: Matter waves, Heisenberg uncertainty principle, Application of Heisenberg's principle, Interpretation of wave function, Significance of ψ and ψ^2, Normalization of wave function Operators and operator algebra, Eigen functions and Eigen values, various operators in quantum mechanics: Linear momentum, Kinetic energy and Total energy operator (only equations no derivations), Postulates of quantum mechanics.

Ref. 1: 3, 5-10, 12, 13, 30, 31, 36, 37, 79-84, 115-121

Ref. 2: 3-9, 18, 27-29, 36-39, 43-48

Ref. 4: 21, 24, 32-36, 38-44

UNIT-2. Chemical Kinetics (L-11, M-15)

The concept of reaction rates. Effect of temperature, Pressure, Catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal initial concentrations of reactants) Half–life of a reaction, Pseudo order reactions, General methods for determination of order of a reaction. Effect of temperature on reaction rate, Arrhenius equation (exponential and integrated form), Collision theory, Concept of activation energy and its calculation from Arrhenius equation, Related numerical.

Ref. 3: 732, 734-744, 751-759

Ref. 4: 970-971, 975-978, 984, 988-990, 992, 993

UNIT-3. Phase Equilibrium (L-11, M-15)

Phases, Components and Degrees of freedom of a system, Criteria of phase equilibrium. Gibbs Phase rule and its thermodynamic derivation. Derivation of Clausius –Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, Congruent and Incongruent melting points (lead-silver, $FeCl_3$-H_2O only), Related Numerical.

Ref. 3: 697-714, 719-721

Ref. 4: 605-607, 609-614, 616, 617, 623, 626, 627, 631, 632

UNIT- 4. Electrochemical Cell (L-12, M-15)

Introduction, overview of electrode processes, Faradaic and Non-Faradaic Processes, Introduction to electrical double layer, Factors affecting electrode reaction rate and current.
Classification of electrochemical cell, EMF expression for chemical cell with and without transference, Liquid junction potential, Types of liquid junction potential, Minimization of liquid junction potential.

Application of EMF measurement for pH using Hydrogen gas electrode, Quinhydrone electrode and Glass electrode, Related numerical.

Ref. 5: 1-4, 9, 10, 12-14, 23, 24, 64, 72, 73, 74

Ref. 4: 807, 808, 811, 812, 816-818

References and Suggested Readings

1. *Quantum Chemistry, Donald A. McQuarie, , Viva student edition, Viva Books*
2. *Quantum Chemistry, 4th edition, R. K. Prasad, New Age international Publishers.*
3. *Essentials of Physical Chemistry, Arun Bahl, B. S. Bahl, G. D. Tuli, S., Multicolor edition, S. Chand Publication.*
4. *Principles of Physical Chemistry, 44th edition, Puri, Sharma and Pathaniya, Vishal Publishing Co.*
5. *Electrochemical Methods Fundamentals and Applications, 2nd edition, Allen J. Bard and Larry R. Faulkner, John Wiley & Sons.*
6. *Chemical Kinetics, 2nd edition, K. J. Laidler,*
7. *An Introduction to Electrochemistry, S. Glasstone, East-West Press.*

Semester VI **Core Course I**

CH-601

Subject- Principles of Physical Chemistry-II

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course objectives

- To learn the basics of molecular spectroscopy and rotational spectra.
- To understand the basic principles and applications of nuclear chemistry.
- To learn the consequences of light absorption by atoms and molecules and photochemical reactions.
- To learn the laws of crystallography and basics of crystal structure.

Learning outcomes

After successful completion of this course, students are expected to:

- Analyze the rotational spectra of diatomic molecules and determine the bond length.
- Explain and apply the radioactivity principles for various chemical and biological investigations.
- Describe the mechanism of fluorescence, phosphorescence and photochemical reactions.
- Analyze the given crystal structure and determine the indices of planes, inter-planer distances and type of crystal structure.

UNIT-1. Investigation of Molecular Structure **(L-11, M-15)**

Introduction, Dipole Moment, Induced dipole moment, Electrical polarization of molecules. Orientation of dipole in an electric field, Debye equation. Method of determination of dipole moment, Vapour temperature method, Molecular structure and dipole moment

Interaction of electromagnetic radiation with molecules, Various types of spectra Rotational, Vibration and Electronic energy levels; with principle and example of each type.

Rotational spectroscopy: Rigid and non-rigid rotor diatomic molecule-Moment of inertia, Energy Levels, Selection rule, Intensities of spectral lines, Determination of bond lengths of diatomic and linear triatomic molecules, Isotopic substitution. Related numerical

Ref. 1: 253-257, 259-261

Ref. 3: 5-9, 33-46

UNIT-2. Nuclear Chemistry **(L-12, M-15)**

Introduction, Radioactive elements, Types of radioactive decay, Decay schemes, General characteristic of radioactive decay, Decay kinetics, Decay constant, Half-life period, Mean life, Units of radioactivity.

Application of radioactivity – Radiochemical principle of tracer technique; Application of tracer technique – Chemical investigation reaction mechanism- esterification, hydrolysis, Oxidation - Oxidation of CO, Structure determination - PCl_5 molecules, Thiosulphate ion, C-14 dating and tritium dating, Medical applications- Thyroditis, Bone fracture Healing, Brain tumor location, Defects in Blood Circulation.

Nuclear Fusion / Fission as source of energy with example

Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management with case study. Related numerical

Ref. 4: 118-125, 225, 247, 248, 373-378, 402, 403, 407-411

Ref. 1: 103-105, 108-110, 113-115, 120-122, 136-138

Ref 6: 87-94, 108-112

UNIT-3. Photochemistry **(L-11, M-15)**

Laws of photochemistry, Quantum yield, Examples of low and high quantum yields, Consequence of light absorption by atoms and molecules, Jablonski diagram, Fluorescence, Phosphorescence, Quenching. Experimental setup for determination of quantum yield with actinometer as detector

Photochemical gas reactions, Photolysis of ammonia, Combination of H_2 and Cl_2 reaction, Reaction between H_2 and Br_2, Photosensitized gas reaction, H_2 and O_2, H_2 and CO, Chemiluminescence, Related numerical.

Ref. 1: 1045-1055

Ref. 2: 1044, 1045, 1048, 1049, 1054, 1055, 1059-1061

UNIT-4. Crystal Structure **(L-11, M-15)**

Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law and Bragg's method. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals: Shottkey and Frenkel defects. Liquid Crystal, Types and Applications. Related numerical

Ref. 1: 449-454, 456-463, 472-474

Ref. 2: 1085-1087, 1099, 1100, 1104-1107, 1123, 1130, 1131

References and Suggested Readings

1. *Essentials of Physical Chemistry, Arun Bahl, B. S. Bahl, G. D. Tuli, S. Multicolor edition, S. Chand Publication.*
2. *Principles of Physical Chemistry, 44th edition, Puri, Sharma and Pathaniya, Vishal Publishing Co.*
3. *Fundamentals of Molecular Spectroscopy, 4th Edition, C. N. Banwell and E. M. McCash, Tata McGraw-Hill: New Delhi*
4. *Essentials of Nuclear Chemistry, Revised 4th Edition, H. J. Arnikar, New Age International Publishers.*
5. *Advance Physical Chemistry, Gurtu and Gurtu, Pragati Publication.*
6. *Environmental Pollution and Health, V. K. Ahluwalia, The Energy and Resources Institute (TERI), 2005.*

Semester V **Core Course II**

CH-502

Subject-Inorganic Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course objectives:

- To describe the VSEPR theory to predict shape of molecules from electron pairs.
- To describe the bonding in simple compounds using VBT.
- To describe the principles of VBT to predict hybridization of orbitals.
- To understand how CFT explains electronic structure, colour and magnetic properties of co-ordination compounds.
- To introduce the basic principles of MOT and electronic geometry of molecules.

Learning outcomes:

- Learn about the VSEPR theory and how it can be used to explain molecular shapes.
- Learn about the VBT to describe the formation of covalent bonds in terms of atomic orbital overlap.
- Learn about stability of complexes using CFSE.
- Learn about MOT to draw energy diagrams and to predict bond order.

UNIT-1: Structure and Reactivity of Molecules **(L-09, M-12)**

Valence Shell Electron Pair Repulsion Theory (VSEPR), Shapes of simple molecules and ions containing lone-and bond-pairs of electrons multiple bonding, prediction of shapes of irregular molecules and ions like - Sulphur tetra fluoride, Bromine trifluoride, Dichloroiodate (I) anion, Penta fluoro telluurate (IV) anion, Tetrachloroiodate (III) anion, Nitrogen dioxide, Phosphorus trihalides, Carbonyl fluoride, Summary of VSEPR rules Drawbacks of VSEPR theory.

Ref.1: 206-207

Ref. 3: Relevant pages.

UNIT 2: Modern Theories of Coordination Compound Part –A (L-09, M-12)

Assumptions, Werner theory and isomerism, EAN, Stability of complex ion, Factors affecting stability of complex ion, Irving William series, Stabilization of unstable oxidation state, Stereochemistry of coordination compound with C.N. 4 and 6, Isomerism in coordination compounds.

Ref. - 1: 735-737, 742-745, 748--757.

Ref. - 2: Relevant Pages.

UNIT 3: Modern Theories of Coordination Compound Part –B (L-09, M-12)

Assumptions of V.B.T., V.B. Theory as applied to structural and bonding in complexes of 3d series elements. Examples of square planar, Tetrahedral and Octahedral complexes, inner and outer orbital complexes, Magnetic properties of complexes of 3d series elements, limitations of V.B.T., Assumptions of CFT, Degeneracy of 'd' orbital's, Application of CFT to octahedral complexes, Weak and strong ligand field splitting, spectrochemical series.

Ref. 1: 759 - 766

Ref.2: Relevant Pages

UNIT 4: Modern Theories of Coordination Compound Part –C (L-09, M-12)

Definition of C.F.S.E., Calculation of C.F.S.E. in weak and strong field octahedral complexes, Evidences of C.F.S.E., Factor's affecting 10 Dq, CFT and magnetic properties, spin only magnetic moment equation, Electron occupancy in CFT, Application of CFT to tetrahedral a nd Calculation of C.F.S.E. in tetrahedral complexes. Tetragonal distortions from octahedral geometry, Jahn-Teller theorem Application of CFT to square planer complexes, Problems related to calculation of spin only magnetic moment for square planer, tetrahedral and octahedral complexes (for high spin and low spin complexes).

Ref.1: 766 -772,

Ref.2: Relevant pages

UNIT 5: Modern Theories of Coordination Compound Part –D (L-09, M-12)

Crystal field effects- Variation of lattice energies, enthalpies of hydration and crystal radii variations in halides of first and second row transition metal series and spinel structures, limitations of CFT, experimental evidences in support of metal ligand bond overlaps. ACFT, Assumptions of Molecular orbital theory, composition of ligand group orbitals, Molecular orbital treatment (Qualitative) of octahedral complexes (strong & weak field), Effect of pi-bonding, Charge transfer spectra, Comparison of VBT, CFT and MOT.

Ref. 1: 794-796,774-778

Ref. 2: Relevant Pages

References:

1. *Principle of Inorganic Chemistry, B. R. Puri, L. R. Sharma, K. C. Kalia, Milestone Publisher and distributor.*
2. *Concise Inorganic Chemistry, 5th Edition, J. D. Lee.*
3. *Inorganic Chemistry Principles of Structure and Reactivity, 4th Edition, James E. Huheey,*
4. *Ellen A. Keiter. Richard L. Keitler.*

Semester VI **Core Course II**

CH-602

Subject- Chemistry of Inorganic Solids

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives:

- To describe basic principles of nanomaterials.
- To describe basic synthesis of nanoparticles.
- To describe composition and technological importance of inorganic solids.
- To describe composition of cement, lime and alloys.
- To describe manufacture of fertilizers.

Learning Outcomes:

- Learn about basic principles and synthesis of nanomaterials.
- Learn about classification, composition and processing of cement.
- Learn about classification and composition of alloys.
- Learn about types manufacture and applications of fertilizers.

UNIT 1: Synthetic Methods of Nanomaterials **(L-09, M-12)**

Introduction to Nano science, nanostructure and nanotechnology (basic idea), Size dependent properties of nanomaterials (basic idea) a) Semiconducting nanoparticles b) Metallic nanoparticles. Synthesis routes of nanomaterials: a) Bottom up approaches i) Chemical vapor deposition (CVD) ii) Spray pyrolysis iii) Sol gel process b) Top down approaches: mechanical alloying, Role of surfactant in shape and size control of nanomaterials

Ref:1: 602-604, 624, 653-655.

Ref:2: 66-70,74-77, 79,85-87.

Ref.3: 656-658, 707-712,721-724

UNIT 2: Inorganic Solids of Technological Importance **(L-09, M-12)**

Inorganic pigments, Coloured solids**,** White and black pigments, Molecular materials and fullerides, Molecular material chemistry – One dimensional metals, Molecular magnets, Inorganic liquid crystals, Solid electrolytes (a) solid cationic electrolytes (b) solid anionic electrolytes .

Ref:- 1: 607-609,642-644,647-650.

Ref.3: 661-664,696-699,703-707.

UNIT 3: Cement and Lime **(L-09, M-12)**

Classification of cement, Ingredients and their role, Manufacture of cement and the setting process, Quick setting cements. Manufacture of lime and applications

Ref.4: Relevant pages

Ref.5: Relevant pages

UNIT 4: Fertilizers **(L-09, M-12)**

Plant Nutrients, Different types of fertilizers, need for fertilizers, requisite qualities of fertilizers, symptom of deficiency, Manufacture of following fertilizers:- Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphate, Super phosphates, Compound and Mixed fertilizers, Potassium chloride and Potassium sulphate.

Ref.5: Relevant pages

Ref.6: Relevant pages

UNIT 5: Alloys **(L-09, M-12)**

Classification of alloys, Ferrous and Non-ferrous alloys, Specific properties of elements in alloys, Manufacture of steel, Removal of silicon, decarburization, demagnetization and desulphurization. Composition and properties of different types of steels

Ref.7: Relevant pages

Ref.8: Relevant pages

Reference:

1. *Inorganic Chemistry, 4th /5th edition, Shriver and Atkins*
2. *Textbook of Nano Science and technology, B. S. Murthy, P. Shankar, Badev Raj, B. B. Rath and James Murday, University Press III M, Metallurgy and Material Sciences.*
3. *Inorganic Chemistry, 6th Edition, Weller, Overton, Rourke & Armstrong.*
4. *Shriver Chemical Process Industry, 5th edition, George T. Austin.*
5. *Industrial Chemistry, 14th edition, B. K. Sharma,2004.*
6. *Riegels Handbook of Industrial chemistry, 9th Edition, James A. Kent, CBS Publishers and Distributors*

7. *Engineering Chemistry, S. S. Dara.*
8. *Engineering Chemistry, B. K. Sharma, Goel Publishing House, Meerut.*
9. *Engineering Chemistry, P. C. Jain and M. Jain Dhanpat Rai and Sons Delhi.*

Semester V **Core Course III**

CH-503

Subject- Organic Reaction Mechanism

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Learning Objectives

- To study different types of organic reactions.
- To understand the mechanisms of different types of reactions.
- To distinguish between types of substrates and types of reagents.
- To understand ways of attack of reagent, breaking and formation of bonds in different reaction mechanisms.
- To study kinetics, evidences and factors affecting different types of reactions.
- To study stereochemistry of different reactions.
- To understand role of different reagents in different reactions.

Course Outcomes

- Students will learn organic reactions like nucleophilic substitution, electrophilic substitution, nucleophilic addition, electrophilic addition and elimination.
- Students will be able to write/ explain mechanisms of those types of reactions.
- Students will understand how a reaction takes place in one or more steps.
- Students will understand the types of intermediates formed in different reactions.
- Students will learn how reagent attacks the substrate molecule and accordingly how bonds break and formed.
- Students will learn how change in structure of substrate, reagent and solvent changes the product formed and its stereochemistry.

- Students will be able to predict the products and to suggest the mechanisms.

UNIT 1. Nucleophilic Substitution at Saturated Carbon (9 L, 12M)

SN^1, SN^2 and SN^i reactions, Mechanism and stereochemistry, regioselectivity and stereo specificity of substitution reaction. Scope at saturated carbon, allylic carbon and vinylic carbon. Factors affecting rate of SN^1, SN^2 and SN^i reactions (Effect of nature of substrate, nucleophile, leaving group and solvent).Neighboring group participation (norbornyl & norbornenyl systems), Non-classical carbocation's.

Ref:- 1: 328-359, 931-937.

Ref:- 2: 293-369.

Ref: - 3: 257-328.

Ref: - 4: 179-200.

UNIT 2. Electrophilic Addition to C=C (9 L, 12M)

Introduction, Mechanism of electrophilic addition to C=C bond (Ad_{E2} Mechanism), addition of hydrogen halides, orientation of addition: Markownikoff's and Anti Markownikoff's addition (peroxide effect), stereochemistry, addition of halogens: experimental evidences for two step mechanism, mechanism of addition of bromine, factors affecting anti-stereoselectivity, effect of substituents on rate of addition, addition of hypohalous acids (HOX), Hydroxylation (Mechanism of formation of cis and trans 1,2-diols), Hydroboration- Oxidation (Formation of alcohol), Hydrogenation (Formation of alkane), Ozonolysis (formation of aldehydes & ketones).

Ref:- 1: 427-447.

Ref:- 2: 734-742, 783-788.

Ref: - 4: 323-360, 425-440

UNIT 3. Nucleophilic Addition to C=O (9 L, 12M)

Introduction, Structure of carbonyl group, reactivity of carbonyl group,

Addition of Hydrogen cyanide, alcohols, thiols, water, ammonia derivatives.

Aldol and Cannizzaro Reaction, Perkin reaction, Wittig reaction, Reformatski reactions,

Reduction reactions using $NaBH_4$, $LiAlH_4$ with mechanism.

Ref:- 1: 222-239.

Ref:- 2: 879-919.

UNIT 4. Aromatic Substitution Reactions **(09 L, 12M)**

Electrophilic substitution

Introduction, arenium ion mechanism, Effect of substituent group (Orientation, o/p directing and meta directing groups). Classification of substituent groups (activating and deactivating groups) Mechanism of: Nitration, Sulfonation, Halogenation, Friedal-Crafts reactions (alkylation and acylation), Diazo Coupling reactions, Ipso-substitution.

Nucleophilic substitution

Addition- elimination (SNAr), Elimination-addition (Benzyne) mechanism with evidences, Chichibabin reaction

Ref:- 1: 471-527.

Ref:- 2: 501-521, 641-653.

Ref: - 4: 517-545, 943-967.

UNIT 5. Elimination Reactions: **(9 L, 12M)**

Introduction, The reaction mechanisms: E1, E2, E1CB with evidences and factors affecting the reaction.E1 v/s E2 and Elimination v/s substitution. Anti and Syn elimination, Stereo electronic factors. Bredt’s rule. Dehydrohalogenation, Dehalogenation, Dehydration, Hoffmann and Saytzeff’s elimination, Pyrolytic elimination.

Ref:- **1: 382-406.**

Ref:- 2 : 982-1010.

Ref: -4 : 273-310.

References

1. *Organic Chemistry, Second Edition. J. Clayden, N. Greeves & S. Warren and P. Wothers (Oxford).*
2. *Advanced Organic Chemistry-Reactions, Mechanisms and Structure, 5^{th} Edition, Michael B. Smith, Jerry March.,Wiley-VCH, Weinheim, 2000,*
3. *Advanced Organic Chemistry Part A- Structure and Mechanisms, 3^{rd} Edition, A. Carey and R.J. Sundberg. Springer US, Third Edition*
4. *Organic Chemistry, 6^{th} Edition, R. T. Morrison and R. N. Boyd.*
5. *Web- Organic Chemistry Portal*

Semester VI **Core Course III**

CH-603

Subject- Spectroscopic Methods of Structure Determination

(Theory: Marks 60 Lectures = 45 hrs) **(Credits: 03)**

Course Objectives

- To study principle of spectroscopy and to understand wave parameters and terms involved in spectroscopy.
- To study different types of spectroscopy.
- To understand principle, concept and the terms used in each type of spectroscopy.
- Interpretation of UV, IR, NMR spectra.
- Use of spectral data for determination of structure of unknown organic compounds.
- To study different applications of each type of spectroscopy.

Learning Outcomes

- Students will learn interaction of radiations with matter. They will understand different regions of electromagnetic radiations. They will know different wave parameters.
- Students will learn principle of mass spectroscopy, its instrumentation and nature of mass spectrum.
- Students will understand principle of UV spectroscopy and nature of UV spectrum. They will learn types of electronic excitations.
- Students will be able to calculate maximum wavelength for any conjugated system. And from the value of λ-max they will be able to find out extent of conjugation in the compound.
- Students will understand principle of IR spectroscopy, types of vibrations and the nature of IR spectrum.

- From IR spectrum, they will be able to find out IR frequencies of different functional groups. And thus, they will be able to find out functional groups present in the compound.
- Students will understand principle of NMR spectroscopy and will understand various terms used in NMR spectroscopy. They will learn measurement of chemical shift and coupling constants.
- Students will be able to interpret the NMR data and they will be able to use it for determination of structure of organic compound.
- Students will be able to determine structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values).

UNIT 1. A) Introduction to Spectroscopy (9L, 12M)

Introduction, meaning of spectroscopy, nature of electromagnetic radiation, wave length, frequency, energy, amplitude, wave number, and their relationship, different units of measurement of wavelength and frequency, different regions of electromagnetic radiations. Interaction of radiation with matter. Excitation of molecules with different energy levels, such as rotational, vibrational and electronic level. Types of spectroscopy, advantages of spectroscopic methods

Ref:- 2: 1-19.

Ref:- 4 : 13-19.

B) Mass spectroscopy

Basic theory, Nature of mass spectrum, Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula.

Ref:- 1: 170-186.

Ref:- 2: 415-424.

Ref:- 3 : 2-15.

Ref:- 4 : 401-417.

UNIT 2. Ultra Violet Spectroscopy (9L, 12M)

Introduction, nature of UV spectrum, Beer's law, absorption of UV radiation by organic molecule leading to different excitations. Terms used in UV Spectroscopy: Chromophore, Auxochrome, Bathochromic shift (Red shift), hypsochromic shift (Blue shift), hyperchromic and hypochromic effect. Effect of conjugation on position of UV band. Calculation of λ-max by Woodward and Fisher rules: for dienes and enone system, Applications of UV Spectroscopy: Determination of structure, determination of stereo chemistry (cis and trans), problems.

Ref:- 1: 1-27.

Ref:- 2: 9-53.

Ref:- 4: 367-398.

UNIT 3. Infra-red Spectroscopy (9 L, 12M)

Introduction, Principle of IR Spectroscopy, fundamental modes of vibrations (3N-6, 3N-5) Types of vibrations (Stretching and bending), Regions of IR Spectrum: functional group region, finger print region and aromatic region, Characteristic IR absorption of functional groups: Alkanes, alkenes, alkynes, alcohol, ethers, alkyl-halides, carbonyl compounds (-CHO, C=O, -COOR, -COOH), amines, amides and Aromatic Compounds and their substitution Patterns. Factors affecting IR absorption: Inductive effect, resonance effect, hydrogen bonding. Applications of IR Spectroscopy: determination of structure, chemical reaction and hydrogen bonding, Problems.

Ref:- 1 : 28-57.

Ref:- 2 : 65-154.

Ref:- 3 : 71-109.

Ref:- 4 : 26-93.

UNIT 4. NMR Spectroscopy (9L,12M)

Introduction, Principles of NMR Spectroscopy, Magnetic and nonmagnetic nuclei, Precessional motion of nuclei without mathematical details, Nuclear resonance, chemical shift, shielding, & deshielding effect. Measurement of chemical shift, delta and Tau-scales. TMS as reference and its advantages, peak area, integration, spin-spin coupling, coupling constants, *J*-value (Only first order coupling be discussed), problems.

Ref:- 1: 63-145.
Ref:- 2 : 185-356.
Ref:- 3 : 144-216.
Ref:-4 : 108-160.

UNIT 5. Combined Problems Based on UV, IR, NMR & Mass (9 L, 12M)

Determination of structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values), coupling constant, peak values provided to the students.

Reference Books:

1. *Spectroscopic Methods in Organic Chemistry, D. H. Williams & I. Fleming, 5th Ed.*
2. *Spectroscopy of Organic Compounds, P. S. Kalsi, New Age Int. Pub., 6th Ed., 2007*
3. *Spectrometric Identification of Organic Compounds, R. M. Silverstein and F. X. Webster , John Wiley and Sons Inc, 7th Edition.*
4. *Introduction to Spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz and J. R. Vyvyan. Indian Edition. Cengage Learning; 5th edition (2015)*

Semester V **Core Course IV**

CH-504

Subject- Industrial Chemistry

(Theory: Lectures 45 hrs, Marks 60) **(Credits: 03)**

Course objectives

- To produce graduates with enhanced skills, applied knowledge, aptitude to carry out higher studies or research and development in the various industrial areas.
- To make the student cognizant about important aspects of Chemical Industries, Industrial work culture and environment.
- To prepare the students for immediate entry to the workplace with sound theoretical knowledge and some basic experimental concepts in the area of various industries viz. Sugar Industry, Fermentation Industry, Petroleum and Petrochemicals.
- To offers the synergism between basic concepts of Chemistry with Industrial applications.
- To equip the students with knowledge of some industrial organic synthesis as requirement of diverse chemical industries.
- Empower the students to understand the concepts in chemical processing, engineering and industrial development.

Learning outcomes

From the course CH: 504 Industrial Chemistry**,** the student will be able to understand….

- Basic requirements of Chemical Industry, different terms, operations and processes involved in chemical Industry.
- Describe Copy Right Act, Patent Act and Trade Marks, Bureau of Indian Standards (BIS) and International Organization for Standardization (ISO).

- Basic requirements, raw materials, different processes and operations involved in Sugar Industry and also different grades of sugar and uses of by-products of sugar industry.
- Importance of fermented products, basic requirements, theory and process of alcohol making, fractional distillation and various terms involved in Fermentation Industry.
- Understand Occurrence of Petroleum, theories of formation of Petroleum and different terms Viz. Knocking, Anti-Knock Compounds, Octane number, Cetane number, Gasohol and Power alcohol etc.
- Manufacturing processes involved in Industrial Organic Synthesis such as Methanol, Isopropanol, Glycerol, Acetylene and Aromatic hydrocarbon i.e. Toluene from petroleum with their uses.

UNIT 1: General Aspects of Industrial Chemistry **(L-9, M-12)**

Introduction, Basic Requirements of Industrial Chemistry, Chemical Production, Raw Materials, Unit Process and Unit Operations, Quality Control, Quality Assurance, Process Control, Research and Development, Pollution Control, Human Resource, Safety Measures, Classification of Chemical Reactions, Batch and Continuous Process, Conversion, Selectivity, Yield, Copy Right Act, Patent Act and Trade Marks. Bureau of Indian Standards (BIS), International Organization for Standardization (ISO)

Ref.1: Chapter 2(26, 27, 31 to 36)

Ref.4: Chapter 1 and 2 (Relevant Pages)

Ref.6: Chapter 1, 2 and 3 (Relevant Pages)

Ref: Websites and Web Pages

www.wikipedia.org/wiki/patentact , www.wikipedia.org/wiki/trademarks,
www.wikipedia.org/wiki/trademarks,www.wikipedia.org/wiki/bis
www.wikipedia.org/wiki/iso

UNIT 2: Sugar Industry **(L-9, M-12)**

Introduction, Sugar Industry in Maharashtra and India, Manufacture of Cane Sugar- [Refining (with flow sheet)], General Idea of Sulphitation and Carbonation, Concentration /Evaporation, Crystallization Separation of crystals. Grades, Baggase, Cellotex

Ref.3: Chapter 38 1208 to 1218 (Relevant Points Only)

UNIT 3: Fermentation Industry (L-9, M-12)

Introduction, Alcohol fermentation, Uses of alcohol, Theory underlying process of making alcohols beverages, Manufacture of Beer, Manufacture of Spirit, Alcohol from Cane Sugar Molasses, Theory of fractional distillation – Coffey'still, Rectified spirit, Absolute alcohol, Fusel oil, Proof spirit, Denatured alcohol.

Ref.2:578-596.

Ref.3: Chapter 36, 1175-1190 (Relevant Points Only)

UNIT4: Petroleum Industry. (L-9, M-12)

Occurrence, Petroleum producer countries in the world, Exploration Methods, Composition of Petroleum, Refining or Distillation of Petroleum, Anti-Knock Compounds, Octane number, Cetane number, Petrohol (their definitions only), Manufacture of Petrol or Gasoline by Bergius Method, Cracking process- Thermal, Catalytic, Hydro cracking.

Ref.1: 340 to 352, 356 to358 and 363 to 368.

Ref.3: Chapter 4, 217 to 311 and Chapter 5, 312 to 342 (Relevant Points only)

UNIT 5: Industrial Organic Synthesis (L-9, M-12)

Manufacture of methanol from synthesis gas, Isopropanol from propylene, Glycerol from propylene via allyl chloride, Acetone by catalytic dehydrogenation of isopropanol. (with flow sheet diagram), Unsaturated Hydrocarbon –preparation of Acetylene from Natural gas (with flow sheet), Aromatic hydrocarbon- Preparation of toluene (with flow sheet)

Ref.3: Chapter 11, 439 to 451 and Chapter 14, 493 to 522 (Relevant Points Only).

References:

1. *Principles of Industrial Chemistry, Chris A Clausen III and Guy Mattson, John Wiley and Sons, Inc. Somerset, 1978, New York.*
2. *Shreve's Chemical Process Industries, George T. Austin, 5 th Edition, The McGraw-Hill, 1984, New York.*
3. *Industrial Chemistry, B. K. Sharma, 16th Edition, Goel Publishing House, Meerut,(U.P.) 2011, India.*
4. *Comprehensive Industrial Chemistry, P.G. More, 1st Edition, Pragati Prakashan, Meerut, (U.P.) 2010, India.*

5. *Chemistry and Technology of the Cosmetics and Toiletries Industry, D.F. Williams and W.H. Schmitt Blackie Academic &. Professional First edition 1992 Second edition 1996 © Chapman & Hall ISBN-13 :978-94-0 10-7194-9 e-ISBN-13:978-94-009-1555-8*
6. *Handbook of Industrial Chemistry Organic Chemicals, Mohammad Farhat AIi, Bassam M. El AIi, James G. Speight, The McGraw-Hill Companies, 2005, ISBN 0-07-141037-6*

Semester VI **Core Course IV**

CH-604

Subject- Chemistry of Industrially Important Products

(Theory: Lectures 45 hrs, Marks 60) **(Credits: 03)**

Course objectives

- To make student perceptive about various commodity industries viz. Cosmetics and Perfumes, Dyes and Pharmaceuticals, Pesticides, Soaps and Detergents, related diversified and multidisciplinary fields of chemical industry.
- To produce graduates with enhanced skills, knowledge and research aptitude to carry out higher studies or research and development in the various industrial areas.
- To equip students with advance knowledge about various industrially important products.
- To makes students ready for immediate entry to the workplace with sound theoretical and basic experimental knowledge in the areas of various industries.
- To engender the substantial interest in the students to understand the concepts in chemical processing, engineering and industrial development of present era viz. Cosmetics and Perfumes Industry, Dyes and Pharmaceuticals, Pesticides, Soaps and Detergents, related multidisciplinary and diversified fields of chemical industry.
- To describe the industrial production of a number of important organic and inorganic compounds / chemicals and products of end use.
- To gain comprehensive knowledge of cutting-edge developments in a field of different chemical industries by discussions and exchange of experiences and knowledge.
- To develop proficiency in application of current aspects of industrial chemistry.

Learning Outcomes

On successful completion of the course **CH: 604 Chemistry of Industrially Important Products**, the student will be able to understand….

- Describe the industrial production of a number of important organic and inorganic compounds / chemicals and products of end use.
- Gain comprehensive knowledge of cutting-edge developments in a field of different chemical industries.
- Importance of Cosmetics Industry and a general study including preparation and uses of the Hair dye, hair spray, shampoo, suntan lotions, lipsticks, talcum powder, nail enamel, creams (cold, and shaving creams).
- Perfumes and identify the distinguishing features of its components and also an essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone etc.
- Know about pesticides both natural and synthetic, benefits and adverse effects of it, also synthesis, manufacture and uses of pesticides viz. Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Anilides (Alachlor and Butachlor).
- Definition, classification, raw material used in soaps and detergents, reaction involved in it, Manufacture of Soaps and cleansing action of soaps and detergents.
- Definition, properties of good dyes, relation between colour and constitution, classification of dyes according to their mode of application and chemical constitution.
- Importance's, definition and meaning of the different terms involved in Drugs and Pharmaceuticals Industry and also synthesis, uses, properties and industrial manufacture of Paracetamol, Aspirin, and Chloramphenicol.

UNIT 1: Chemistry of Cosmetics **(L-9, M-12)**

Introduction, Raw materials and general study including preparation and uses of the following: Hair dye, shampoo, suntan lotions, lipsticks, talcum powder, nails enamel, creams (cold and shaving creams).

Ref.: 6 Chapter -1, 1 to 34, Chapter -2, 36 to 100, Chapter -3, 104 to 145, Chapter - 4 149 to 181 and Chapter- 9, 290 to 309. Relevant Points Only

UNIT 2: Chemistry of Perfumes **(L-9, M-12)**

Essential oils A general study including properties, uses and importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone and antiperspirants and artificial flavours.

Ref. 3: Chapter 53, 1520 to1544 Relevant Points Only.

Ref.6: Chapter 8, 272 to 289, Chapter 10, 310 to 344, Relevant Points Only.

UNIT 3: Pesticide Chemistry **(L-9, M-12)**

General introduction to pesticides and their changing concepts (natural and synthetic), benefits and adverse effects of pesticides, structure activity relationship, synthesis and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion); Anilides (Alachlor and Butachlor).

Ref.3: Chapter 41, 1280 to1318 Relevant Points Only.

Ref.7: Chapter 11, 381 to 426 Relevant Points Only.

UNIT 4: Soap and Detergents **(L-9, M-12)**

Soaps, Surfactants and its Importance, Raw Materials used in Soap Manufacture, Manufacture of Soaps (Continuous Process), Cleansing action of Soap, Classification of Soaps, Detergents, Principal group of Synthetic Detergents, Detergents builders and Additives, Comparison between Soap Detergent.

Ref.3: Chapter 39, 1219 to1251 and Chapter 40,1252 to1279 Relevant Points Only.

Ref. 6: Chapter- 5, 123 to160 Relevant Points Only.

UNIT 5: Dyes, Drugs and Pharmaceuticals. **(L-9, M-12)**

(a) Dyes: Introduction, properties of dyes, Otto Witts theory only, Classification of dyes according to their mode of application and Chemical Constitution.

Ref.3: Chapter 54, 1545 to1608 Relevant Points Only.

Ref.6: Chapter 8, 259 to 288 Relevant Points Only.

(b) Drugs and Pharmaceuticals: Introduction, Importance, Qualities of good drugs, Functional and chemotherapeutic drugs, Meaning of the terms: Prescriptions, Doses, Analgesic, Antipyretics, Antibiotics, Anti-inflammatory, Anti-viral, Cardiovascular, Cough and Cold Preparations, Sedatives and Hypnotics, contraceptives. Synthesis, uses, manufacture and properties of Paracetamol, Aspirin, Chloramphenicol

Ref.4: Chapter 8, 144 to194 Relevant Points Only.

Ref.6: Chapter 10, 331 to 379 Relevant Points Only.

References:

1. *Principles of Industrial Chemistry, Chris A Clausen III and Guy Mattson, John Wiley and Sons, Inc. Somerset, 1978, New York.*
2. *Shreve's Chemical Process Industries, George T. Austin, 5 th Edition, The McGraw-Hill, 1984, New York.*
3. *Industrial Chemistry, B. K. Sharma, 16th Edition, Goel Publishing House, Meerut,(U.P.) 2011, India.*
4. *Comprehensive Industrial Chemistry, P.G. More, 1stEdition, Pragati Prakashan, Meerut,(U.P.) 2010, India.*
5. *Chemistry and Technology of the Cosmetics and Toiletries Industry, D.F. Williams and W.H. Schmitt Blackie Academic &. Professional First edition 1992 Second edition 1996 © Chapman & Hall ISBN-13 :978-94-0 10-7194-9 e-ISBN-13:978-94-009-1555-8*
6. *Handbook of Industrial Chemistry Organic Chemicals, Mohammad Farhat AIi, Bassam M. El AIi, James G. Speight, The McGraw-Hill Companies, 2005, ISBN 0-07-141037-6*

Semester V **Skill Enhancement Course**

CH-505

Subject- Analytical Instrumentation

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives

- To develop an understanding of the range and uses of analytical methods in chemistry.
- To understand and establish the role of chemistry in quantitative analysis.
- To enhance the Analytical instrumental skill of the students.

Learning Outcomes

- Explain the fundamentals of analytical methods and instruments for qualitative and quantitative Analysis.
- Express the role of analytical chemistry in science.
- Students will be able to function as a member of an interdisciplinary problem solving team.

UNIT 1:-Spectrometry **(9L, 12M)**

Origin of spectra Interaction of electro-magnetic radiation with matter, Electro-magnetic Spectrum, The Absorption of Radiation, Solvents for Spectrometry, Quantitative Calculations, Beer's Law, Principles of instruments - Sources, Monochromators (prism, diffraction gratings, Optical filters), Cells, detectors, Slits Width, Single Beam Spectrometer, Spectrometric Errors, Deviation from Beer's Law - Chemical deviation, Instrumental deviation, Problems.

Ref.-1:- 398-401, 410-411, 413--435, 439-443.
Ref. 2 -6:-Relevant Pages

UNIT 2: Infrared Spectrometry **(9L, 12M)**

Infra red Spectrometry – Principles, Theory, Instrumentation, Source, monochromator, detectors, Single beam, Double beam, Types, Sampling Technique, Solvents, Spectrometric error, FTIR introduction, General applications.

Ref.-2: 447 – 458

Ref.-4: 527-576

Ref. 2-6: Relevant Pages

UNIT 3. A: Emission Spectrometry **(9L, 12M)**

Flame Emission Spectroscopy – Principles, Theory, Instrumentation, Experimental techniques, Interferences and applications , Advantages and disadvantage, Plasma Emission Spectrometry – Principles, Plasma as excitation source, inductively coupled Plasma source, ICP-AES Instrumentation, Applications.

Ref.-1: 462 - 467

Ref. 2-6: Relevant Pages

B:-Atomic Absorption Spectrophotometry

Introduction, Principles, Advantages over FES, Instrumentation – Sources, Burners, Flames, Interferences – Spectral Interferences, Ionization Interferences, Refractory Compound Formation,Hallow cathode lamps, Physical Interferences, Use of Organic Solvents, Sample Preparation, Applications of AAS. Comparison of AAS with atomic emission methods

Ref.-1: 467 - 475

Ref. 2-6:Relevant Pages

UNIT 4:-Potentiometry **(9L, 12M)**

Potentiometer, The Cell for Potential Measurements, Combination Electrode, Theory of Glass Membrane Potential, The Alkaline Error, The Acid Error, Standard Buffers, Ion-selective Electrodes - Glass Membrane Electrodes, Precipitate Electrodes, Solid-State Electrodes, Liquid-Liquid Electrodes, Plastic Membrane/Ionophore Electrodes, Coated Wire electrodes, Enzyme Electrodes.

Ref.-1: 312-313,316-325

Ref.-2 -6: Relevant Pages

UNIT 5:-P^{H}metry **(9L, 10M)**

Introduction to pH meter, The Glass pH Electrode Principle, Accuracy of pH Measurements, Measurements with the pH-meter, Making the pH Measurement, Fundamental limitations, Maintenance.

Ref.-8: 327-333

Ref.-2 - 8: Relevant Pages

Reference Books:-

1. *Analytical Chemistry, G.D. Christian, 5th Edition.*
2. *Analytical Chemistry Principal- J. H. Kennedy. 2nd Edition (1990)*
3. *Analytical Chemistry, An Introduction, Skoog, West and Holler, 6 th Edition*
4. *Instrumental Method of Chemical Analysis, Chaitwal and Anand, 5th Edition.*
5. *Basic Concept of Analytical Chemistry, S.M. Khopkar*
6. *Instrumental Methods of Chemical Analysis- Willard, Merritt, Dean and Settle, 6th Edition*
7. *Introduction to Instrumental Analysis, R.D. Braun*
8. *Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, 6th Edition,*

Important Instrument web links

Instruction Manual Operation Guide UV-1800 Shimadzu Spectrophotometer,

http://www.sustainable-desalination.net/wp-content/uploads/2013/05/UV-1800.pdf

Instruction Manual Operation Guide Agilent 5500 Series FTIR,

https://www.agilent.com/cs/library/usermanuals/public/5500_series_ftir_operation_manual.pdf

Instruction Manual Operation Guide Agilent 700 Series ICP Optical Emission Spectrometers,

https://www.agilent.com/cs/library/usermanuals/public/8510230100_700SeriesICP_UserManual.pdf

Instruction Manual Operation Guide Flame Atomic Absorption Spectrometry,

https://www.agilent.com/cs/library/usermanuals/Public/0009.pdf

Instruction Manual Operation Guide Potentiometry,

http://nhp.mowr.gov.in/docs/HP2/MANUALS/Water%20Quality/5014/-download-manuals-WaterQuality-WQManuals-32PotentiometricAna.pdf

http://shop.hannasingapore.com/media/pdf/2016-01-11-HI901C-Full.pdf

User Manual pH meter F-71, HORIBA, Ltd. 2011

http://library.metergroup.com/Manuals/Horiba/BenchtopPh/F-71%20Manual.pdf

Semester VI **Skill Enhancement Course**

CH-605

Subject- Analytical Techniques

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives

- To provide knowledge of instruments which are used in Chemical, Pharma, Petroleum, and insecticide and pesticide industry
- To increase student technical skill as per industry need.
- To develop an understanding of the range and uses of analytical methods in chemistry.

Learning Outcomes

- Compare the Instrumental methods and non instrumental methods and there advantages.
- Solve the problem of detection and separation using analytical instruments.
- Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
- Students will be able to explain why chemistry is an integral activity for addressing social, economic, and environmental problems.

UNIT 1:- Solvent Extraction **(9L, 12M)**

The Distribution Co-efficient, The Distribution Ratio, Percent Extracted, Solvent Extraction of Metals - Ion Association Complex and Metal Chelates, The Extraction Process, The Separation Efficiency of Metal Chelates, Analytical Separations, Multiple Batch Extractions, Countercurrent Distribution, Simple numerical problems on Percent Extracted and Multiple Extraction, Problems

Ref.1: 484 to 498.

Ref. 2-6: Relevant Pages

UNIT 2:- High-Performance Liquid Chromatography (9L, 12M)

Introduction, Principles, Equipment for HPLC, Choice of Column Materials for HPLC, Application

Ref.1: 537 to 545

Ref.2-6: Relevant Pages

UNIT 3:- Gas Chromatography (9L, 12M)

Introduction, Principles, Gas chromatography Columns, Gas Chromatography Detectors, Column Efficiency in Chromatography- Theoretical Plates, 1) Van Deemter Equation, 2) Capacity Factor and 3) Resolution, Problems

Ref.1: 522 to 528, 511 to 515

Ref.2-6:- Relevant Pages

UNIT 4:- Ion Exchange Chromatography (9L, 12M)

Introduction, Cation Exchange Resins, Anion Exchange Resins, Cross-linkage, Effect of pH Separation of Amino Acids, Effect of Complexing Agents-Separation of Metal ions on Anion Exchange Columns, Applications of Ion Exchange Chromatography

Ref.1: 517 to 522

Ref. 2-6: Relevant Pages

UNIT 5:-Thermal Methods (9L, 12M)

General Discussion, Thermogravimetry- Instruments for thermogravimetry, Applications of thermogravimetry, Differential Techniques- Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC), Instruments for DTA and DSC, Experimental and Instrumental Factors, Applications of DTA and DSC, Problems

Ref.-6: 503 - 519

Ref. 1-6: Relevant Pages

Reference Books:-

1. *Analytical chemistry, G.D. Christian, 5th Edition,*
2. *Instrumental Methods of Chemical Analysis, Chatwal and Anand*
3. *Basic Concept of Analytical Chemistry, S.M. Khopkar, 2nd edition,*
4. *Chemical Analysis by A. K. Shriwastawa, P. C.Jain, S. Chand and Company.*
5. *Quantitative Analytical Chemistry, James S. Fritz, George H.Schenk,5th Edition.*
6. *Vogel's Text Book of Quantitative Chemical Analysis, J. Mandham, R.C.Denney, J. D. Barnes, M. Thomas, B. Shivashankar, 6th Edition.*

Important Instrument web links

The LC Handbook Guide to LC Columns and Method Development,

https://www.agilent.com/cs/library/primers/public/LC-Handbook-Complete-2.pdf

Handbook and user manual of Gas chromatography

https://www.agilent.com/cs/library/usermanuals/Public/G3430-90011.pdf

Handbook and user manual of Ion Exchange Chromatography

https://www.agilent.com/cs/library/primers/Public/5991-3775EN_BioIEX_HowTo_LR.pdf

Handbook and user manual of Ion Differential Scanning Calorimetry

https://www.perkinelmer.com/CMSResources/Images/46-74542GDE_DSCBeginnersGuide.pdf

Semester V **Elective Course**

CH-506(A)

Subject- Biochemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Learning Objectives

- To study different types of biomolecules.
- To study structure of biomolecules.
- To study classification of each type of biomolecules.
- To study reactions of the biomolecules.
- Study of metabolism and thus, study of metabolic processes and reactions involved.
- To study energetics of the metabolic processes.
- Students should understand: Structure and role of Carbohydrates, Amino acids, Proteins, Enzymes, lipids, Nucleic Acids and energy rich compounds in biochemical reactions.

Course Outcomes

- Students will study biomolecules like carbohydrates, amino acids, proteins, enzymes, lipids and nucleic acids.
- Students will understand definitions, classifications and examples of these biomolecules.
- Students will learn the detailed structure of these biomolecules along with types of bonds or linkages present in their molecules.
- Students will learn the chemical properties of these biomolecules and the action of some reagents on them in the form of reactions or graphical presentation.
- Students will understand biochemical energetics of common energy rich compounds along with hydrolytic reactions.

- Students will learn metabolisms like Glycolysis, TCA cycle, Transamination, deamination and β- oxidation through reactions, enzymes involved, outlines and energetics.

Unit 1. Carbohydrates (L-09, M-12)

a) Introduction, definition, classification.

b) Monosaccharaides: structure of glucose (open chain and ring structures). Kiliani Fischer synthesis of D-glucose. Reactions of glucose: oxidation with bromine water and nitric acid, reduction, acetylation, addition of HCN, NH_2OH and phenyl hydrazine, mutarotation.

c) Disaccharides: structure of sucrose, lactose and maltose.

d) Polysaccharides: storage polysaccharides, structure of starch, Structural polysaccharides, structure of cellulose.

Ref 1 and 2: Relevant pages

Unit 2. Amino Acids and Proteins (L-09, M-12)

a) Amino acids: Introduction, structure of ammo acids, classification of amino acids, amphoteric nature of amino acids, reactions of amino acids: with FDNB and Dansyl chloride, formation of peptide bond

b) Proteins: Introduction, classification of proteins: based on functions and based on shape, structure of proteins: primary, secondary, tertiary and quaternary structure). Study of some proteins: α keratins and hemoglobin. Separation of amino acids and proteins by paper electrophoresis and dialysis

Ref 1 and 2: Relevant pages

Unit 3. Enzymes and Lipids (L-09, M-12)

a) Enzymes: Introduction, specificity of enzymes, classification, role of enzymes in biochemical reactions, Michaelis Menten equation (no derivation). Effect of substrate concentration, P^H and temperature on enzyme catalyzed reactions. Enzyme inhibitors: introduction and types.

b) Lipids: Introduction, classification of lipids, fatty acids, nomenclature of fatty acids, triacyl glycerols, hydrogenation of oils, Saponification value and iodine value of oils, phospholipids and waxes.

Ref 1 and 2: Relevant pages

Unit 4. Nucleic Acids and Energy Rich Compounds (L-09, M-12)

a) **Nucleic acids**: Introduction, Components of nucleic acids: sugars, bases, nucleosides and nucleotides. Watson and Crick model of DNA, types of RNA (structure not expected)

b) **Energy rich compounds**: Introduction, Pyrophosphates, acyl phosphates, enolic phosphates, thiol esters (structure, hydrolytic reaction and energetics). Energy carriers in biological redox systems: NAD^+ and FAD

Ref 1 and 2- Relevant pages

Unit 5. Metabolism (L-09, M-12)

Definition of metabolism,

a) Carbohydrate metabolism: Glycolysis: reactions involved and energetics, TCA cycle (Kreb cycle): Reactions involved and energetic

b) Amino acid Metabolism: Transamination, deamination (by enzymes - glutamic dehydrogenase, ammonia lyases, deaminases and deamidases), decarboxylation

c) Lipid Metabolism: β- oxidation of fatty acids, reactions involved in β –oxidation, energetics of β –oxidation of palmitic acid.

Ref 1 and 2- Relevant pages

Reference Books

1. *Outlines of Biochemistry, Conn and Stumpf (4th Edition)*
2. *Principles of Biochemistry, A. L. Lehninger (2nd Edition)*

Semester V **Elective Course**

CH-506(B)

Subject- Green Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives:

- There is rising concern since 1970 about environmental pollution, depleting resources, climate change, ozone depletion, legislation which is getting stringent with strict environmental laws, rising cost of waste deposits, health concern and so on.
- We are facing the challenge to work towards sustainable development. Since 1990, today's society is moving towards becoming more and more environmentally conscious.
- Green chemistry has been introduced in1990 for overall sustainable development against the environmental concerns.
- Green chemistry is not a new branch of chemistry, but it is a new way chemistry, which should be practiced regularly.
- Innovations and applications of green chemistry in education has helped companies not only to gain environmental benefits but at the same time to achieve economic and societal goals also.
- This is possible because these undergraduate students are ultimate scientific community of tomorrow.

Learning Outcomes:

- With this course, the graduate students will be able to understand the twelve principles of green chemistry that will help to build the basic understanding of toxicity, hazards and risk of chemical substances.
- The course will help to understand stoichiometric calculations and relate them to green chemistry metrics. The students will learn about atom economy and understand its importance over percentage yield.

- The students will learn to design safer chemicals, products and processes that are less toxic than the conventional chemistry, understand significance of catalysis, use of renewable feed stock, renewable energy sources, importance of green solvents, etc.
- The course will train the students to appreciate green chemistry and boost the students to think and develop the skills to innovate and search for the solutions to environmental problems.
- Green chemistry is only way of future chemistry to ensure sustainability with absolute zero waste. The success stories and real-world cases will motivate the young generation to practice green chemistry.

UNIT 1. Introduction to Green Chemistry **(L-04, M-04)**

Definition of Green Chemistry. Drawbacks of conventional chemistry. Need of Green Chemistry, Minamata Disease. Goals of Green Chemistry

Ref:1 Relevant Pages

Ref:6 Relevant Pages

UNIT 2. Principles of Green Chemistry and Designing a Chemical Synthesis **(L-12, M-18)**

Twelve principles of Green Chemistry, role of Paul T. Anastas, importance of green chemistry with examples: Prevention of waste/by-products, Atom economy, Prevention or Minimization of hazardous products, Designing safer chemicals, Energy requirements for synthesis, Selection of suitable solvents, Selection of starting materials, Use of protecting groups, Use of catalysts, Designing of biodegradable products, Prevention of chemical accidents, Strengthening of analytical techniques, industrial safety.

Ref:1 Relevant Pages

Ref:2 Relevant Pages

UNIT 3. Techniques in Green Chemistry **(L-12, M-16)**

a) Microwave assisted synthesis- Introduction and importance, Applications- Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels-Alder Reaction,Hofmann Elimination.

b) Ultrasound assisted reactions- Introduction and importance, Application- Esterification, saponification, aromatic substitution reactions, alkylation, oxidation, reduction.

Ref:1 Relevant Pages

Ref:3 Relevant Pages

UNIT 4. Solvents, Reagents and Catalysts in Green Chemistry (L-14, M-18)

a) Solvents- Introduction and Importance, Examples-Michael Addition in water, Bis-indolyl methane in ionic liquid, tetrazole synthesis in deep eutectic solvent.

b) Reagents- Introduction and Importance, Examples- Alkylation using dimethyl carbonate, Solid phase peptide synthesis using Merrifield reagent.

c) Catalysts- Introduction and Importance, Examples- Reduction of carbonyl group using Baker's yeast, Esterification using Lipase enzyme, Zeolite clay and Cyclodextrin.

Ref:1 Relevant Pages

Ref 2: Relevant Pages

UNIT 5. Future Trends in Green Chemistry (L-03, M-04)

Biomimetic, Photochemical reactions, Multifunctional Reagents, Green chemistry in sustainable development.

Ref:1 Relevant Pages

Ref 3: Relevant Pages

Ref 5: Relevant Pages

Reference Books:

1. *New Trends in Green Chemistry, V.K. Ahluwalia and M.R. Kidwai: Anamalaya Publishers (2005).*
2. *Green Chemistry- Theory and Practical, P.T. Anastas and J.K. Warner: Oxford University Press (1998).*
3. *Introduction to Green Chemistry, A. S. Matlack: Marcel Dekker (2001).*
4. *Real-World Cases in Green Chemistry, M.C. Cann & M.E. Connely: American Chemical Society, Washington (2000).*
5. *Introduction to Green Chemistry, M. A. Ryan & M. Tinnesand, American Chemical Society, Washington, (2002).*
6. *Silent Spring, Rachel Carson, Houghton Mifflin Company, (1962).*

* * * * *

Semester VI **Elective Course**

CH-606(A)

Subject- Polymer Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Learning Objectives

- The course offers the basic concepts of polymer, polymerization, classes of polymers, important properties, and poly(lactic acid) as a biodegradable polymer.
- The course also offers to study preparation, properties, and applications of industrially important selected polymers.
- The course will give chance to study various mechanisms of polymerization and learn different techniques of polymerization.
- The student will be able to understand glass transition temperature and factors affecting on it and various ways to express molecular weight of polymers.

Course Outcomes

After completing this course, the graduate should be able to

- Define terms like monomer, polymer, polymerization, polydispersity index, etc., classify polymers based on their origin, native backbone chain, and thermal response.
- Know glass transition temperature and its determination, various ways to express molecular weights of polymers and polydispersity index.
- Identify different mechanisms of polymerizations *viz*. free radical, ionic, and condensation polymerizations.
- Distinguish techniques of polymerization based on physical conditions required for the preparation of polymers in laboratory or industry.
- Familiar with preparation, properties, and applications of industrially important selected polymers.

UNIT 1. Basic Concepts of Polymers **(L-09, M-12)**

Introduction, brief history, monomers and polymers, degree of polymerization, functionality, linear, branched and cross linked polymers, homopolymers, Types of copolymers:- random, alternate, block and graft copolymers, Tacticity (stereochemistry) of polymers: isotactic, syndiotactic and atactic polymers. Classification of polymers:- based on a) origin- natural and synthetic polymers b) native backbone chain – organic and inorganic polymers c) thermal response – thermoplastic and thermo setting polymers d) ultimate form and use – plastic, elastomer, fibre and liquid resin, Degradation of polymers:- types of degradation: chain end and random degradations.

Ref. 1 and 2: Relevant pages

UNIT 2. Chemistry of Polymerization **(L-09, M-12)**

Introduction, chain growth polymerization (initiation, propagation, termination, and kinetics): free radical polymerization, ionic (cationic and anionic) polymerizations, step growth polymerization (mechanism and kinetics), ring opening polymerization.

Ref. 1 and 2: Relevant pages

UNIT 3. Polymerization Techniques & Polymer Processing Techniques

(L-9, M-12)

Polymerization techniques: - Bulk polymerization, solution polymerization, suspension polymerization, emulsion polymerization, interfacial condensation polymerization.

Polymer processing techniques:- Calendaring, die casting, film casting, and compression moulding.

Ref. 1 and 2: Relevant pages

UNIT 4. Study of Some Important Polymers **(L-09, M-12)**

Preparation, properties and applications of - Polyethylene [PE], Polypropylene [PP], Poly(vinyl chloride) [PVC], Polystyrene [PS], Polyacrylonitrile [PAN], Polycarbonates [PC], Phenol-formaldehyde resins [PF], Epoxy resins, Polyester - Polyethyleneterephthalate[PET], Polyamides (Nylon-6 and Nylon-6,6), Poly(vinyl alcohol) [PVA], Poly(lactic acid) [PLA], Polyaniline, and Polybutadiene.

Ref. 1 and 2: Relevant pages

UNIT 5. Glass Transition Temperature **(L-09, M-12)**

Glass transition temperature:- Definition and explanation, factors affecting glass transition temperature, Glass transition temperature and molecular weight, Glass transition temperature and melting point, importance of glass transition temperature, determination of glass transition temperature by dilatometry.

Molecular weights of polymers:-types of molecular weights-number average molecular weight, weight average molecular weight, viscosity average molecular weight, sedimentation average molecular weight, and poly dispersity index.

Ref. 1 and 2: Relevant pages

Reference Books

1. *Polymer Science, V. R. Govarikar, N. V. Viswanathan, JayadevSreedhar, New Age International (P) Ltd., New Delhi, 1997.*
2. *Text books of Polymer Science, F. W. Billmeyer, John Wiley & Sons; 3rd edition,1984.*

Semester VI **Elective Course**

CH-606(B)

Subject- Research Methodology for Chemistry

(Theory: Lectures = 45 hrs, Marks 60) **(Credits: 03)**

Course Objectives:

- To familiarize students towards basics of research, process of research and methods.
- To enable the student in conducting research work and formulating research synopsis and report.
- To learn the analysis of primary research articles and peer review articles.
- To improve student understanding of how scientific questions are developed and posed through proposals and dissemination of research results.
- To learn the scientific method of collecting and analyzing information.
- To learn the presentation of scientific information
- To aware the students about proper laboratory safety and techniques.

Learning outcomes:

The learning outcomes for this course of the following Chemistry Graduate Program Goals:

- Students will learn about what is research, research methods and impact of chemical research on society through pure and applied research.
- Students will learn how to analyze research in chemistry drawn from contemporary primary chemical literature.
- Student will formulate thesis topic, explain its significance and propose the methodology to be used in the thesis topic research.
- Student will demonstrate proficiency in scientific writing which includes:

- Ability to interpret and synthesize primary research literature related to the student's thesis topic.
- Ability to write a coherent narrative that explains the significance of the thesis research with regard to the primary research literature.
- Ability to report original research results in a coherent narrative.
- Ability to explain and defend conclusions draw from original results in narrative form.
- Prepare and present scientific topics orally utilizing presentation software such as PowerPoint.

- Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
- Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
- Students will be able to communicate the results of scientific work in oral, written and electronic formats.
- Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behaviour in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine.

UNIT 1: Introduction to Research **(L-9, M-12)**

Definition of Research, Objectives of Research, Importance, and need for Research in a related field. Motivation in Research Methods versus Methodology, Classification and types of Research, Pure and applied Research, Difference between Computational lab and wet lab research, theoretical and experimental models, Criteria of Good Research Application of theoretical knowledge in designing of experiments. Methods of Data Collection

List of National Importance Institutes and List of CSIR Laboratories

Ref. 3: 1-24.

UNIT 2: Print Literature Resources **(L-9, M-12)**

Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index with examples.

Ref. 1: 299-317;

Ref. 2: 1569-1603

UNIT 3: Digital Literature Resources (L-9, M-12)

The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information. Web resources, E-journals, Journal access, TOC alerts, Citation index, Impact factor, H-index, UGC infonet, E-books. The introduction of Search engines, Scirus, Google, Google Scholar, Chem Industry, Wiki- Databases, ChemSpider, American Chemical Society, Royal Society of Chemistry, Wiley-inter science, Science Direct, Springer, SciFinder, Scopus, C&EN News Reaxys.

Ref. 1: 299-317;

Ref. 2:1569-1603

UNIT 4: Writing Scientific Reports (L-9, M-12)

Writing Skills, Reporting practical and project work, Referencing, Organizing a poster display. Communication Skills, Body Language, Giving an oral presentation. Content of Research Papers, How to download Research Paper? How to Read Research Paper, Abstract and Summary. What are Paper, Patent and Review? Introduction of Plagiarism and self Plagiarism.

Ref. 1: 325-348; Ref. 3: 344-360.

UNIT: 5 Chemical Safety and Ethical Handling of Chemicals (L-9, M-12)

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, incineration and transportation of hazardous chemicals.

Ref. 6: 1.31–1.36, 1.40, 2.1-2.16, 5.79-5.85, 7.41-7.50, 8.25-8.31.

Reference Books:

1. *Practical Skills in Chemistry, 2nd Ed, .Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. and Jones, A. Prentice-Hall, Harlow (2011)*
2. *APPENDIX A: The Literature of Organic Chemistry March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Seventh Edition, by Michael B. Smith and Jerry March Copyright John Wiley & Sons, Inc. (2013)*
3. *Research Methodology: Methods And Techniques, 3rd edition, Kothari, C.R. Published by New Age International (P) Ltd., Publishers (2004),*
4. *How to Use Excel in Analytical Chemistry and in general Scientific Data Analysis. Levie, R. de, Cambridge Univ. Press (2001).*
5. *Chemical Safety Matters – IUPAC – IPCS, Cambridge University Press, (1992).*
6. *OSU Safety Manual 1.01*
7. *Laboratory Safety for Chemistry Students, Hill R. H., Finster D. C. 8th ed.; John Wiley and Sons: Hoboken, NJ, March (2017).*

T.Y.B.Sc. Chemistry

Semester -V **Course No:- CH-507**

Subject: Physical Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives

- To develop skills required in chemistry such as the appropriate handling of apparatus, instruments and chemicals.
- The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
- To expose the students to an extent of experimental techniques using modern instrumentation.
- The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

Learning Outcomes

- Students will get basic analytical and technical skills to work effectively in the various fields of chemistry.
- Students will able to calibrate and handle instruments like conductometer, potentiometer, pH meter, colorimeter, spectrophotometer, polarimeter.
- They have ability to perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation, interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.
- They get skills required in chemistry such as the proper handling of apparatus and chemicals.
- They will have ability to present scientific and technical information resulting from laboratory experimentation in both written and oral formats.

- Students will apply conductometer, potentiometer, pH meter, colorimeter, spectrophotometer, polarimetery techniques for analysis and measurement.

Instructions:

- The student should perform at least 10 experiments from each semester. It is expected to perform at least one experiment from each technique.
- Use dilute solutions and in minimum amount.
- Use 50 ml volumetric flasks for preparation of solutions
- Scientific calculators (non-programmable) and practical handbooks are allowed during practical examination.

Conductometry:

1. Conductometric titration of mixture of acids and hence determine the strength of acids.
2. Determine the degree of hydrolysis and hydrolysis constant of sodium acetate conductometrically.

Potentiometry:

1. Determine Ecal and pH of buffer solution (Citric acid + Na_2HPO_4) using quinhydrone electrode.
2. Determine the pKa and Ka of weak monobasic acid by potentiometric titration.

P^{H}metry:

1. Determine the amount of aspirin in the given tablet.
2. Determine the pKa of various mixtures of sodium acetate and acetic acid in solution and hence to find the dissociation constant.

Polarimetry:

1. To study the kinetics of inversion of cane sugar by polarimeter.
2. Determine the concentration of given solution of an optically active substance (cane sugar) by polarimetric measurement.

Flame Photometry:

3. Estimation of Na / K by flame photometer in the given sample.

Refractometery:

1. Determine the refractive indices of series of KCl solution and hence unknown concentration of given KCl solution**.**

Chemical Kinetics:

1. Study the hydrolysis of methyl acetate in presence of hydrochloric acid.
2. Determine the energy of activation of the reaction between $K_2S_2O_8$ and KI. (Equal initial concentration)
3. Investigate the kinetics of iodination of acetone (zero order reaction).

Viscosity:

1. Determine the molecular weight of high polymer using its solution of different concentration.

Partition coefficient:

1. Determine the partition coefficient of iodine between carbon tetrachloride and water**.**

T.Y.B.Sc. Chemistry

Semester -VI **Course No:- CH-607**

Subject: Physical Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Instructions:

- The student should perform at least 10 experiments from each semester. It is expected to perform at least one experiment from each technique.
- Use dilute solutions and in minimum amount.
- Use 50 ml volumetric flasks for preparation of solutions.
- Scientific calculators (non programmable) and practical handbooks are allowed during practical examination

Conductometry:

1. Determine the relative strength of monochloro acetic acid and acetic acidconductometrically.
2. Determine the basicity of organic acid by conductometric measurement.

Potentiometry:

1. Determine the amount of sodium chloride in a given solution by potentiometric titration with silver nitrate.
2. Determine formal redox potential of Fe^{2+} to $Fe^{3+}$by potentiometric titration.

Colorimeter / Spectrophotometer:

1. Determination of λ max and concentration of unknown Cu^{2+} solution and verify Beer's law.
2. Verify Beer's law, determine unknown concentration and molar extinction coefficient of Potassium permanganate.

P^{H}metry:

1. Determine the pKa and Ka of weak monobasic acid by pH metric titration.
2. Determine the degree of hydrolysis and hydrolysis constant of aniline hydrochloride pH metrically.

Polarimetry:

1. Determine the percentage of two optically active substances (d- sucrose and d-tartaric acid) in a mixture polarimetrically**.**

Radioactivity:

1. Determine the E_{max} of Beta particle.

Refractometry:

1. Determine the refractive index of four liquids, hence specific and molarrefraction.
2. Determine the molar refraction of homologous methyl, ethyl and propylalcohol and show that constancy configuration to molar refraction by $–CH_2$group.

Chemical Kinetics:

1. Investigate the reaction between H_2O_2 and KI by gas burette method.
2. Determine the order of the reaction between potassium persulphate and potassium iodide by fractional change method.

Viscosity:

1. Determine the radius of glycerol/sucrose molecule by viscosity measurement.

References:-

1. *Findley's Practical Physical Chemistry, B.P.Levitt, 9th Edition, Longman group Ltd.*
2. *Advanced Physical Chemistry Experiments, J.N.Gurtu and Amit Gurtu, Pragati Prakashan*
3. *Systematic Experimental Physical Chemistry S.W. Rajbhoj, Dr. T.K. Chondekar, 3rd edition, Anjali Publication, Aurangabad.*
4. *Experimental Physical Chemistry, V.D.Athawale, P. Mathur, New age International Ltd,New Delhi.*
5. *Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing House, Meerut*
6. *Advanced Practical's in Physical Chemistry. Dr. Pande, Dr. Mrs. Datar, Dr. Mrs. Bhadane, 4th revised Edition, Manali Publication, Pune.*
7. *Experimental Physical Chemistry, R.C. Das, B.Behra, Tata McGrawHill.*

STRUCTURE OF INTERNAL PRACTICAL EXAMINATION

Time allowed – 3 Hours **Marks – 40**

Q.1	Any One experiment from (CH-507/607)	**30 Marks**
Q.2	Oral	**10 marks**

		Total: 40 Marks

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed: 3 Hours **Marks: 60**

Semester V (CH-507)

Q. 1.	Any One experiment from CH-507	**40 Marks**
Q.2	Oral	**10 Marks**
Q.3	Certified Journal	**10 Marks**

		Total: 60 Marks

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed: 3 Hours **Marks: 60**

Semester VI (CH-607)

Q. 1.	Any One experiment from CH-607)	**40 Marks**
Q.2	Oral	**10 Marks**
Q.3	Certified Journal	**05 Marks**
Q.4	Industrial Tour Report	**05 Marks**

-

Total: 60 Marks

T.Y.B.Sc. Chemistry

Semester -V **Course No:- CH-508**

Subject: Inorganic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives:

- To analyze the inorganic mixtures.
- To determine metal from ore and alloy analysis.
- Using colorimetric analysis to determine amount of metal.

Learning outcomes:

- Student will able to determine cation & anion from inorganic mixtures by using qualitative analysis.
- Student will able to determine metal from ore & alloys.
- Students will be able to design & carry out scientific experiments as well as accurately record & analyze the results of experiments.
- Students will be able to handle colorimeter for estimation of metal ions.

1. **Inorganic Qualitative Analysis: (Any Five)**
   Binary mixtures containing common anions (Excluding phosphates and borates)
2. **Ore Analysis: (Any Two)**
   i) Heamatite ore - Estimation of Iron volumetrically
   ii) Pyrolusite ore- Estimation of Manganese volumetrically
   iii) Dolomite ore - Estimation of Calcium volumetrically
3. **Alloy Analysis: (Any Two)**
   i) Estimation of Zn from Brass alloy .
   ii) Estimation of Tin gravimetrically as SnO_2 from solder alloy.
   iii) Estimation of Copper iodometrically from nichrome alloy.
   iv) Determination of iron gravimetrically from stainless steel.
4. **Colourimetric analysis (any one)**
   i) Colourimetric titration of Cu(II) against EDTA method .
   ii) Estimation of Titanium using hydrogen peroxide.

IMPORTANT NOTE:

- For volumetric analysis pipette out solution should be 10 ml
- Preparation of stock solution or standard solution should be in **100/50ml volumetric flask** in order to avoid wastage of chemicals.

References

1. *A Text Book of Quantitative Inorganic Analysis, A. I. Vogel, 4th edition*
2. *Vogel's Qualitative Inorganic Analysis, A. I. Vogel.*
3. *Practical Chemistry, O. P. Pandey, D. N. Bajpai, S. Giri, S. Chand Publication, New Delhi.*
4. *Post Graduate Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S.* ***R.*** *Puniyani, Himalaya Publishing House.*
5. *College Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S.R. Puniyani, Himalaya Publishing House.*
6. *Practical Chemistry, K. K. Sharma, D. S. Sharma, Vikas Publication.*

T.Y.B.Sc. Chemistry

Semester -VI **Course No:- CH-608**

Subject: Inorganic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives:

- To determine metal from gravimetric estimations.
- To determine amount of metal by volumetric analysis.
- To determine preparation /synthesis of co-ordination compound.
- To study separation techniques of metals.
- To use colorimetric analysis of metal.

Learning Outcomes:

- Students will be able to prepare co-ordination compounds.
- Students will be able to determine amount of metal by using quantitative analysis.
- Students will be able to calculate Rf value of metal.
- Students will be able to design & carry out scientific experiments as well as accurately record & analyze the results of experiments.
- Students will be able to explain why chemistry is an integral activity for addressing social, economic & environmental problems.

1. **Gravimetric Estimations: (Any Two)**
   i) Fe as Fe_2O_3
   ii) Zn as $Zn_2P_2O_7$
   iii) Pb as lead chromate
   iv) Al as Al_2O_3
2. **Volumetric Analysis: (Any Two)**
   i) Manganese by Volhards method.
   ii) Estimation of Nickel by EDTA method.
   iii) Determination of strength of NaOH and Na_2CO_3 in a given solution.

iv) Estimation of ferrous and ferric by dichromate method.

3. **Inorganic Preparations: (Any Three)**
   i) Bis (ethylenediamine) copper (II) sulphate.
   ii) Potassium trioxalato chromate (III).
   iii) Tris (acetylacetonato) Iron (III).
   iv) Hexaaquonickel (II) chloride.
   v) Potassium tris oxalatoaluminate (III)trihydrate.
   vi) Synthesis of ZnO nanoparticles using Zinc acetate dihydrate

4. **Colourimetric Analysis: (Any One)**
   i) Estimation of iron using thiocynate method.
   ii) To determine the concentration of cobalt in the given solution using R-nitroso salt by colourimetry.

5. **Paper Chromatography: (Any Two mixtures)**
   Separation and identification of binary mixture of cations (Fe^{3+}, Ni^{2+}, Cu^{2+}, Co^{2+}, Mn^{2+}, Zn^{2+})

IMPORTANT NOTE:

- For volumetric analysis pipette out solution should be 10 ml
- Preparation of stock solution or standard solution should be in **100/50 mL volumetric flask** in order to avoid wastage of chemicals.

References:

1. *A Text Book of Quantitative Inorganic Analysis, 4th edition, A. I. Vogel,*
2. *Vogel's Qualitative Inorganic Analysis, A. I. Vogel.*
3. *Practical Chemistry, O. P. Pandey, D. N. Bajpai, S. Giri, S. Chand Publication, New Delhi.*
4. *Post Graduate Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker,* ***S.*** *R. Puniyani, Himalaya Publishing House.*
5. *College Practical Chemistry, H. N. Patel, S. P. Turakhia, S. S. Kelker, S.R. Puniyani Himalaya Publishing House.*
6. *Practical Chemistry, K. K. Sharma, D. S. Sharma, Vikas Publications.*

STRUCTURE OF PRACTICAL EXAMINATION

Inorganic Chemistry Practical

CH-508, Semester-V

Internal Examination Pattern

Time Allowed: 3Hrs. **Max. Marks: 40**

Q 1. Inorganic Qualitative Analysis/Ore Analysis/ Alloy Analysis	**30 Marks**
Q 2. Oral	**10 Marks**
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	40 Marks

External Examination Pattern

Time Allowed: 3Hrs. **Max. Marks: 60**

Q 1. Inorganic Qualitative Analysis/Ore Analysis/ Alloy Analysis	**40 Marks**
Q 2. Oral	**10 Marks**
Q 3. Journal (completed and certified)	**10 Marks**
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	60 Marks

Inorganic Chemistry Practical

CH-608, Semester-VI

Internal Examination Pattern

Time Allowed: 3Hrs. Max. Marks: 40

Q 1. Gravimetric Estimations/Volumetric Analysis/colorimetric Analysis/ Inorganic Preparation and Paper Chromatography	**30 Marks**
Q 2. Oral	**10 Marks**
	40 Marks

External Examination Pattern

Time Allowed: 3Hrs. Max. Marks: 60

Q 1. Gravimetric Estimations/Volumetric Analysis/colorimetric Analysis/ Inorganic Preparation and Paper Chromatography	**40 Marks**
Q 2. Oral	**10 Marks**
Q 3. Journal (completed and certified)	**05 Marks**
Q 4. Industrial Tour Report	**05 Marks**
	60 Marks

T.Y.B.Sc. Chemistry

Semester -V **Course No: - CH-509**

Subject: Organic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) **(Credits: 02)**

Course Objectives

- To develop skills required in chemistry such as the appropriate handling of apparatus and chemicals.
- The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
- To expose the students to an extent of experimental techniques using modern instrumentation.
- The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

Learning Outcomes

- Separate and analyze binary water insoluble mixture.
- Separate and analyze binary water soluble mixture.
- Estimate - Acetamide, Glucose and Glycine by volumetric method,
- Estimate basicity of various acids.
- Synthesis of various organic compounds through greener alternatives.
- Understand Thin Layer Chromatographic techniques and physical constant.
- Understand the purification technique use in organic chemistry.

I) Separation of Binary Mixtures and Qualitative Analysis **(Any 6)**

a) Solid-Solid (4 Mixtures) b) Solid-Liquid (1 Mixture) c) Liquid-Liquid (1 Mixture)

At least one mixture from each of the following should be given-Acid-Base, Acid-Phenol, Acid-Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral and Neutral- Neutral. (Solid-solid mixtures must be insoluble in water)

Note:

- Students are expected to determine type of the mixture and to separate the mixture.
- Separation of the Mixture should be done by chemical method only.
- It is expected to perform preliminary tests, physical constants, detection of elements and determination of functional groups of separated compounds.
- On the basis of above tests, students are expected to determine structure of compounds.
- The separated compounds should be purified and then melting point of purified compound should be determined. The purified samples of the separated components should be submitted.
- Separation and qualitative analysis of the binary Mixtures should be carried out on micro scale using micro scale.

II) Organic Estimations **(Any 2)**

1. Estimation of acetamide
2. Estimation of basicity (Number of -COOH groups) of acid
3. Estimation of glycine
4. Saponification value of oil

III) Green Chemistry Preparation **(Any 2)**

1. Synthesis of acetanilide from aniline by using Zn dust / acetic acid.
2. Synthesis of dibenzalpropanone from benzaldehyde and acetone. using $LiOH.H_2O/NaOH$
3. Synthesis of p- bromo acetanilide from acetanilide by using KBr.
4. Synthesis of dihydropyrimidinone from ethyl ace to acetate, benzaldehyde and urea
5. Diels-Alder reaction between furan and maleic acid [4+2] Cycloaddition Reaction

T.Y.B.Sc. Chemistry

Semester -VI **Course No:- CH-609**

Subject: Organic Chemistry Practical

(Practical: Lectures = 60 hrs, Marks 60) (Credits: 02)

I) Organic preparations (Any 6)

1. Benzoquinone from Hydroquinone (Oxidation by $KBrO_3$ or $K_2Cr_2O_7$)
2. Preparation of Sudan-I (Diazocoupling)
3. p-nitroacetanilide from Acetanilide (Nitration)
4. 2-Naphthyl ether from 2-Naphthol (Methylation by DMS, NaOH)
5. Hippuric acid from Glycine (Benzoylation)
6. p-Iodonitrobenzene from p-Nitroaniline (Sandmeyer Reaction)
7. m- Nitro aniline from m-Dinitrobenzene (Reduction)
8. Benzoic acid from Ethyl benzoate (Ester hydrolysis)
9. Isolation of Starch from Potato
10. Adipic acid from Cyclohexanone (Oxidation by Con. HNO_3)

II) Preparation of derivatives (Any 3)

1. Oxime derivative of aldehydes or Ketones
2. Aryloxy acetic acid derivative of Phenol
3. 2, 4 DNP derivative of aldehydes or Ketones
4. Glucosazone derivative of Glucose
5. Anilide derivative of acid

III) Purification techniques (Any 1)

1. Solvent extraction using separating funnel
2. Preparative TLC
3. Steam distillation

Note:

- The Preparation or derivative should be carried out on small scale and the starting compound should not be given more than one gm.

- Purity of the sample in Preparation and derivative can be checked by thin layer Chromatography (TLC).
- If product is impure, it should be purified.
- The Head of the Department must see that the industrial tour will be arranged collectively by the Department staff members.

Reference Books

1. *Practical Organic Chemistry, A. I. Vogel, Pearson, 5th Edition, 2005.*
2. *Practical Organic Chemistry, O. P. Agarwal, Krishna Prakashan Media (P) Ltd, 2014.*
3. *University Practical Chemistry, P. C. Kamboj, Vishal Publishing Co.; 1st (Reprint) Edition, 2013.*
4. *Comprehensive Practical Organic Chemistry-Qualitative Analysis, V. K. Ahluwalia and Renu Aggarwal, Universities Press, 2016.*
5. *R.B. Woodward and H. Baer, J. Am. Chem. Soc. 1948, 70, 1161.*
6. *D. C. Rideout and R. Breslow, J. Am. Chem. Soc. 1980, 102, 7816.*
7. *Green Chemistry: Theory and Practice, Anastas, P.T and Warner, J.C. Oxford University Press (1998).*
8. *Monograph on Green Chemistry Laboratory Experiments, Green Chemistry Task Force Committee, DST*

STRUCTURE OF INTERNAL PRACTICAL EXAMINATION

Time allowed – 3 Hours **Marks – 40**

Q.1 Any One experiment from CH-509/609)	**30 Marks**
Q.2 Oral	**10 marks**

STRUCTURE OF EXTERNAL PRACTICAL EXAMINATION

Time allowed: 3 Hours **Marks: 60**

Semester V (CH-509)

Q.1 Separation of Binary Mixtures and Qualitative Analysis of any one Compound **OR** Organic Estimation **OR** Green Chemistry Experiment	**40 Marks**
Q.2 Oral	**10 Marks**
Q.3 Journal (completed and certified)	**10 Marks**

Semester VI (CH-609)

Q.1 Organic Preparation / Derivative / Purification technique	**40 Marks**
Q.2 Oral	**10 Marks**
Q.3 Journal (completed and certified)	**05 Marks**
Q.4 Industrial Tour Report	**05 Marks**

Instructions

- In case of binary mixture experiment, examinee should identify type of mixture and should separate the mixture. After separation, examiner should ask the examinee to analyze any one compound from the mixture.
- In case of preparation of organic compounds and derivatives, product should be purified by recrystallization.
- Industrial tour is compulsory for each student.

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon
T.Y.B.Sc Chemistry
(CBCS) Pattern equivalence

Equivalence in accordance with titles and contents of papers (for revised syllabus from June 2020) are as follows…

Sr. No.	Title of Old Paper		Title of New Paper	
	Semester-V			
1.	CH -351	Physical Chemistry	CH – 501	Principles of Physical Chemistry-I
2.	CH -352	Inorganic Chemistry	CH – 502	Inorganic Chemistry
3.	CH -353	Organic Chemistry	CH – 503	Organic Reaction Mechanism
4.	CH -354	Analytical Chemistry	CH – 504	Industrial Chemistry
5.	CH -355	Industrial Chemistry	CH – 505	Analytical Instrumentation
6.	CH -356 (A)	Bio Chemistry	CH – 506 (A)	Biochemistry
7.	CH -356 (B)	Environment Chemistry	CH – 506 (B)	Green Chemistry
8.	CH -357	Physical Chemistry Practical	CH – 507	Physical Chemistry Practical
9.	CH -358	Inorganic Chemistry Practical	CH – 508	Inorganic Chemistry Practical
10.	CH -359	Organic Chemistry Practical	CH – 509	Organic Chemistry Practical
11.		Non-Credit Audit Course **(Any One)**	AC-510	NSS
			AC-511	NCC
			AC-512	Sports
	Semester-VI			
1.	CH -361	Physical Chemistry	CH - 601	Principles of Physical Chemistry-II
2.	CH -362	Inorganic Chemistry	CH - 602	Novel Inorganic Solids
3.	CH -363	Organic Chemistry	CH - 603	Spectroscopic Methods of Structure Determination
4.	CH -364	Analytical Chemistry	CH - 604	Chemistry of Industrially Important Products
5.	CH -365	Industrial Chemistry	CH - 605	Analytical Technique
6.	CH -366 (C)	Polymer Chemistry	CH – 606 (A)	Polymer Chemistry
7.	CH -366 (D)	Chemistry In Every Day Life	CH – 606 (B)	Research Methodology for Chemistry
8.	CH -367	Physical Chemistry Practical	CH – 607	Physical Chemistry Practical
9.	CH -368	Inorganic Chemistry Practical	CH – 608	Inorganic Chemistry Practical
10.	CH -369	Organic Chemistry Practical	CH - 609	Organic Chemistry Practical
11.		Non-Credit Audit Course **(Any One)**	AC-610	Soft Skill
			AC-611	Yoga
			AC-612	Practicing Cleanliness

‘A’ Grade
NAAC Re-Accredited
(3rd Cycle)

KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

Academic Curriculum
(For Affiliated Colleges of KBC NMU)

M. Sc. Part-1
CHEMISTRY
(Semester I and II)

Choice Based Credit System (60:40 Pattern)
(Outcome Based Curriculum)
As Per U.G.C. Guidelines

To Be Implemented From

Academic Year 2021-22

SYLLABUS

M. Sc. Part-1
CHEMISTRY (Semester I and II)

Summary of Distribution of Credits under CBCS Scheme
[at affiliated colleges w.e.f. academic year 2021-22]

Sr. No.	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	**12**	**12**	**12**	**08**
02	Core Skill Based	**02**	**20**	**-**	**12**
03	Elective	**-**	**-**	**04**	**04**
04	Project	**-**	**-**	**-**	**06**
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**16**	**34**	**18**	**32**

Subject Type	Core	Core Skill Based	Elective	Project	Audit	Total
Credits	**44**	**34**	**08**	**06**	**08**	**100**

Total Credits = 100

Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon

M. Sc. Part-1 Chemistry (Sem-I and II)
[at affiliated colleges w.e.f. academic year 2021-22]

Choice Based Credit System (Outcome Based Curriculum)

Course credit scheme

Semester	(A) Core Courses			(B) Core Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	3	12	**12**	1	2 + 0	02	1	2	2	**16**
II	3	12	**12**	4	2 + 18	20	1	2	2	**34**
III	3	12	**12**	1	4 + 0	04	1	2	2	**18**
IV	2	08	**08**	4	4 + 18	22	1	2	2	**32**
Total Credits	**44**			**48**			**8**			**100**

(T, Theory; P, Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	**Prerequisite and Core Courses**									
	Theory	14	4	14	4	12	3	08	2	48
	Practical	-	-	18	3	-	-	18	3	36
(B)	**Core Skill Based / Subject Elective Courses**									
1	Theory /Practical	-	-	-	-	4	1	4	1	08
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1							2
2	Personality and Cultural Development Related Course			2	1					2
3	Technology Related + Value Added Course					2	1			2
4	Professional and Social + Value Added Course							2	1	2
	Total Credit Value	16	5	34	8	18	5	32	7	100

***List of Audit Courses** (Select any ONE course of Choice from Semester II; Semester III and Semester IV)*

Semester I (Compulsory)		**Semester II** (Choose One) **Personality and Cultural Development**		**Semester III** (Choose One) **Technology + Value Added Course**		**Semester IV**(Choose One) **Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Practicing Sport Activities	AC-301B	Cyber Security	AC-401B	Current Affairs
		AC-201C	Practicing Yoga	AC-301C	Molecular Docking	AC-401C	Technical Report Writing
		AC-201D	Introduction to Indian Music	AC-301D	Seminar on Review of Research Paper	AC-401D	Intellectual Property Rights (IPR)

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

Syllabus under CBCS for M. Sc. Part-I Chemistry
Syllabus Structure (w.e.f. 2021-22)
Semester-I

Course Code	Course Type	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th (L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CH-110	Core	Physical Chemistry-I	04	--	04	40	--	60	--	100	--	04
CH-130	Core	Inorganic Chemistry-I	04	--	04	40	--	60	--	100	--	04
CH-150	Core	Organic Chemistry-I	04	--	04	40	--	60	--	100	--	04
CH-190	Core Skill Based	Industrial Safety and Good Laboratory Practices	02	--	02	20	--	30	--	50	--	02
AC-101	**Audit Course**	Practicing Cleanliness	--	02	02	--	100	--	--	--	100	02

Semester-II

Course Code	Course Type	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th (L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CH-210	Core	Physical Chemistry-II	04	--	04	40	--	60	--	100	--	04
CH-230	Core	Inorganic Chemistry-II	04	--	04	40	--	60	--	100	--	04
CH-250	Core	Organic Chemistry-II	04	--	04	40	--	60	--	100	--	04
CH-290	Core Skill Based	Instrumentation and Analysis	02	--	02	20	--	30	--	50	--	02
*CH-P-1	Core Skill Based	Physical Chemistry Practical-I	--	06	06	--	40	--	60	--	100	06
*CH-I-1	Core Skill Based	Inorganic Chemistry Practical-I	--	06	06	--	40	--	60	--	100	06
*CH-O-1	Core Skill Based	Organic Chemistry Practical-I	--	06	06	--	40	--	60	--	100	06
AC-201 (A)/ (B)/(C)/(D)	**Audit Course**	Choose one out of four (AC-201 A/B/C/D) (Personality and Cultural Development Related)	--	02	02	100	--	--	--	100	--	02

*** To be started from Semester-I & evaluated at the end of Semester-II**

List of elective courses to be offered in Semester-II:

AC-201 (A): Soft Skills	**AC-201 (C): Practicing Yoga**
AC-201 (B): Practicing Sports Activities	**AC-201 (D): Introduction to Indian Music**

Syllabus for M.Sc. Part-I Chemistry

(Semester - I & II)

Course Structure for First Year

Course Code	Course Type	Title of the Course
		Semester – I
CH-110	Core	Physical Chemistry-I
CH-130	Core	Inorganic Chemistry-I
CH-150	Core	Organic Chemistry-I
CH-190	Core Skill Based	Industrial Safety and Good Laboratory Practices
AC-101	Audit Course	Practicing Cleanliness
		Semester – II
CH-210	Core	Physical Chemistry-II
CH-230	Core	Inorganic Chemistry-II
CH-250	Core	Organic Chemistry-II
CH-290	Core Skill Based	Instrumentation and Analysis
CH-P-1	Core Skill Based	Physical Chemistry Practical-I
CH-I-1	Core Skill Based	Inorganic Chemistry Practical-I
CH-O-1	Core Skill Based	Organic Chemistry Practical-I
AC-201 (A)/ (B)/(C)/(D)	**Audit Course**	Choose one out of four (AC-201 A/B/C/D) (Personality and Cultural Development Related) AC-201 (A): Soft Skills AC-201 (B): Practicing Sports Activities AC-201 (C): Practicing Yoga AC-201 (D): Introduction to Indian Music

Important Notes:

1. Each theory course prescribed for M. Sc. should be covered in 4 lectures, each of 60 minutes duration per week per course including lectures, tutorials, seminars, classroom discussions etc. (Total 60 hrs. / theory course)

2. Each practical course will require 06 hours of laboratory work per week and will be extended over two semesters. All three practical courses will be examined at the end of the academic year. (Total 180 hrs. / practical course)

3. There should not be more than 10 students in a batch for M. Sc. Practical course.

4. For theory course, the question paper (Internal/External) should include numerical, short answer, long answer, MCQ questions, problem solving approach to test understanding of the subject.

5. In the 60 lectures theory course about 10 lectures will include tutorials, student seminars, classroom discussions and tests.

6. The marks for each paper are distributed as external examination 60 marks and internal examination 40 marks. For internal assessment of each theory and practical course, 2 written tests will be taken.

7. The 75 % attendance of students is compulsory.

8. Students should visit at least five chemical industries in the first year of M. Sc. and submit the observations/report to the Department.

Semester-wise Course Structure of M.Sc. Organic Chemistry

Program at a Glance

Name of the program (Degree)	: M. Sc. (Organic Chemistry)
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60 : 40 Pattern (60 marks University exam and 40 marks continuous internal departmental exam/assessment)
Passing standards	: 40% in each exam separately (separate head of passing)
Evaluation mode	: CGPA
Total Credits of the program	: 100 (44 core credits including 6 credits of project/dissertation, 34 skill enhancement credits, 08 subject elective credits and 08 audit credits)

CH-110: Physical Chemistry - I
(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. To learn the principals and foundations of quantum chemistry.
2. To get oriented towards the basic theory underlying the chemical bond.
3. To acquire knowledge about the different possible equilibrium in nuclear decay processes.
4. To learn the basic concepts about the interaction of high energy radiations with matter.
5. To learn the theory and concepts behind the electrochemical processes and ionic equilibria.

Unit No.	Name of the unit	Lectures
1	**Essentials of Quantum Chemistry** Recapitulation of basic concepts of quantum chemistry, Schrodinger equation, normalization with examples, Hermitian operator and its theorems, postulates of quantum mechanics, free particle, particle in one dimensional box and its application for excitation energies in linear conjugated systems, two and three dimensional box, wavefunction and probability density plots, degeneracy, simple harmonic oscillator, energy eigenvalues, Ψ and Ψ^2 plots, even and odd functions, rigid rotator, spherical polar coordinates, separation of variables and energy values. Hydrogen atom Schrodinger wave equation (derivation not expected), radiation distribution functions, dependence of spherical harmonics of angles (shape of orbitals only introduction), and related numerical. **Ref. 2, 3, 4, 6, 8**	**12**
2	**Chemical Bonding** Variation principle, approximation, LCAO-MO, H_2^+ molecular ion, importance of coulomb and exchange integrals, Born-Oppenheimer approximation and the approximated Hamiltonian, VBT to H_2 molecule (derivation not expected) Comparison between MOT and VBT, valence electron approximation, HMO theory and its application to ethylene and butadiene. **Ref. 2, 3, 4, 6, 8**	**12**
3	**Nuclear Chemistry** Parent-daughter decay-growth relationships: daughter nucleus stable, general expression for activity of daughter, parent shorter and longer lived than daughter, parent and daughter of nearly the same half-life, secular and transient equilibrium. Applications of radioactivity: Typical reactions involved in the preparation of radio isotopes (^{22}Na, ^{32}P), Szilard - Chalmer's reaction, Isotope dilution and neutron activation analysis, and related numerical **Ref. 5, 8**	**12**
4	**Radiation Chemistry** Elements of radiation chemistry: primary effects of interaction of radiation with matter, LET, Bremsstrahlung. Interaction of gamma radiation with matter: photoelectric effect, Compton scattering and pair production, units of measuring radiation absorption. Radiation dosimetry: units of dose, Fricke and Ceric sulphate dosimeters, conversion of measured dose values and related numerical.	**12**

	Ref. 5, 8	
5	**Electrochemistry** Strong electrolytes, ionic strength, activity and activity coefficients of strong electrolytes, Debye Huckel theory of conductivity (derivations not expected), ionic atmosphere, relaxation and electrophoretic effects, DHO equation (mathematical derivation not expected), its validity and deviations, Debye-Huckel theory of activity coefficients: Debye-Huckel limiting law (derivation expected), its testing and deviations. Transport number: definition and its relation to ionic mobility, Moving boundary and Hittorf's theoretical and experimental method and related numerical **Ref. 1, 6, 7, 8**	**12**

References:

1. P. W. Atkins, J. D. Paula, Physical Chemistry, Oxford University Press
2. Donald McQuerry , Quantum Chemistry, Viva Books
3. R. K. Prasad, Quantum Chemistry, New Age International
4. I. Levine, Quantum Chemistry, Pearson Education
5. H. J. Arnikar, Essentials of Nuclear Chemistry
6. D. A. McQuerry & J. D. Simon, Physical Chemistry Molecular Approach, Viva Books
7. S. H. Maron and C. F. Prutton, Principles of Physical Chemistry, Oxford and IBH Publishing Co.
8. Dr. L. S. Patil, Physical Chemistry I, Shree Book Co. Mumbai

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Apply the quantum mechanical principles to simple systems of chemical interests	**3**
2	Differentiate between the nature of chemical bond concept from MOT and VBT	**2**
3	To identify and write the different types of equilibriums in a given nuclear decay process	**4**
4	To explain the concept of Radiation dose measurement and its practical applications	**2**
5	To be able to calculate the ionic strength and activity coefficients by using the basic concepts underlying.	**5**

CH-130: Inorganic Chemistry - I

(60 L, 100 Marks and 4 Credits)

Course Objectives:

1. The course offers the basic concepts of inorganic chemistry lying on synthesis, structure, bonding and properties of some selected main group elements.
2. The course helps to build up a conceptual framework for understanding the principles and theories for chemical bonding and properties of inorganic compounds.
3. The course furnishes detail knowledge about synthesis, types of bonding, properties etc.

Unit No.	Name of the unit	Lectures
1	**Molecular Symmetry and Applications** Molecular term symbol for homonuclear diatomic molecules H_2,B_2,C_2,N_2,$O_2$and F_2 molecules Linear tri-atomic molecules – BeH_2, CO_2. Trigonal planar molecule- BF_3, Tetrahedral Molecule – CH_4, Trigonal pyramidal molecule NH_3, Angular Tri-atomic molecules H_2O, NO_2.	**12**
2	**Organometallic compounds of transition metals** Organometallic compounds, molecule orbital theory and 18 electron rule, counting electrons in complexes, alkyl and aryl complexes, alkene complexes, metal π complexes- metal carbonyl and metal nitrosyls.	**12**
3	**Chemistry of non-transition elements** Hydrides-classification, electron deficient, precise and rich hydrides. Study of PH_3, SbH_3, AsH_3, Selenides, Tellurides. Synthesis, properties and structures of alkali and alkaline earth metal compounds, Synthesis and reactivity of inorganic polymer of Si and P.	**12**
4	**Molecular symmetry** Symmetry elements and operations, symmetry planes, reflections, inversion centre, proper / improper axes of rotation, equivalent symmetry elements and atoms, symmetry elements and optical isomerism, Classification of point groups and procedure to determine the point group, with at least one example of each point group.	**12**
5	**Transition Metal Carbonyls and Related Compounds** Introduction, preparation and properties of transition metal carbonyls, structure of transition metal carbonyls, carbonyl hydrides, carbonylate anions and cations, carbonyl halides, phosphine and phosphorous trihalide complexes, dinitrogen complexes, nitric oxide complexes, cyano complexes.	**12**

References:
1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry Principles of Structures and R eactivity, 4th edition, New York, NY: Harper Collins College Publishers, 1993.
2. J. D. Lee, Concise Inorganic Chemistry, 5thedn., Blackwell Science, London, 2006.
3. A. G. Sharpe, Inorganic chemistry, 3rd edition, ISBN 9788131706992, Pearson Education, 1981.
4. F.A. Cotton, Chemical Applications of Group Theory,ISBN: 978-0-471-51094-9, 1990.
5. D.F. Shrivers, P.W. Atkins and C.H. Langfor, Inorganic Chemistry, CH Langford, 1990.
6. B.R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., 2005.
7. H. B. Gray, Electrons and Chemical Bonding. W. A. Benjamin, Inc., New York, 1965.
8. H. J. Emeleus and A.G. Sharpe, Modern Aspects of Inorganic Chemistry, Universal Book S tall, New Delhi.
9. K. Lal, S.K. Agarwal, Advanced Inorganic Chemistry, Pragati Prakashan, Meerut, 2017
10. G. S. Manku, Theoretical Principles of Inorganic Chemistry, Tata McGraw-Hill Ed
11. B. Douglas, D.H. Mc. Daniel, J.J. Alexander, Concepts and Models of Inorganic Chemistr, 2nd edition.
12. R. Sarkar, General and Inorganic Chemistry, Part one, New Central Book Agency, Kolkat.
13. P. K. Bhattacharya, Group Theory and its Chemical applications, Himalaya Publishing Ho use.
14. F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, Advance Inorganic Chemistr, Si xth Edition, John Wiley & Sons, Inc.

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Apply the fundamental knowledge about the synthesis, structure, bonding and properties of some selected main group elements which are very important in different fields.	**3**
2	Apply fundamental knowledge about molecular symmetry, MOT, organometallic compounds, ionic solids and bioinorganic compounds.	**3**
3	Explain various concepts and theories of various topics from inorganic chemistry.	**2**

CH-150: Organic Chemistry – I (60 L, 100 Marks and 4 Credits)		
Course Objectives: To make the students conversant with the 1. Study of basic concepts of organic chemistry. 2. Study of reaction intermediates. 3. Study of the different classes, mechanism & stereochemistry of reactions.		
Unit No.	**Name of the Units**	**Lectures**
1	**Aromaticity** Huckel's (4n+2) and 4n rules. Aromatic and antiaromatic compounds up-to 18 carbon atoms. Homoaromatic compounds. Aromaticity of all benzenoid systems, heterocycles, azulenes, tropolones, fulvenes, sydnones, annulenes, aromatic ions and Fullerene (C60). **Ref. 3. Page No. 40-67** **Ref. 5, 7, 9 Relevant pages**	**04**
2	**Reactive Intermediates and Concerted Reactions** **(Carbocations, Carbanions, Carbene, Nitrene, and Arynes)** Organic reactive intermediates and their structure, methods of generation, structure, stability and important reactions involving carbocations, carbanions, nitrenes, carbenes, arynes. **Ref. 3. Page No. 165-186, 195-202** **Ref. 4, 5, 6 Relevant pages**	**10**
3	**A. Nucleophilic Substitution reaction** **Aliphatic nucleophilic substitution** a) S_N1, S_N2 and S_N^i mechanism and stereochemistry (regioselectivity and stereospecificity of substitution reaction). b) Nucleophilic substitution at an allylic, aliphatic and vinylic carbon. c) Effect of substrate structure, nucleophile, leaving group and solvent on rate of $S_N1$and S_N2 reactions, ambident nucleophile. **Aromatic nucleophilic substitution** S_NAr, S_N1, Benzyne and S_NR1 reactions, effect of substrate structure, leaving group, solvent and attacking nucleophile. **B. The neighbouring group mechanism** The neighbouring group mechanism, neighbouring group participation by π and σ bonds, anchimeric assistance. Non-classical carbocations, phenonium ions, norbornyl system. **Ref. 2. Page No. 406-443.** **Ref. 3. Page No. 255-262, 265-272, 286-289, 298-320** **Ref. 4, 5, 7, 8, 10 Relevant pages**	**14**
4	**Electrophilic Substitution reaction** a) Arenium ion mechanism, orientation and reactivity, energy profile diagram, ortho, para, ipso attack, orientation in other ring systems, six and five membered heterocycles with one hetero atom. b) Important reactions like Friedel crafts alkylation and acylation, nitration, halogenation, formylation, chloromethylation, sulphonation, diazo coupling.	**12**

	Ref. 1. Page No. 447-562 **Ref. 2, 3, 4, 5, 7, 8 Relevant pages**	
5	**Addition reaction** a) Addition to carbon-carbon multiple bonds and carbon heteroatom multiple bonds- Mechanism and stereochemical aspects of addition reaction involving electrophile. b) Structural effects and reactivity: Halogenations, Hydrohalogenation, Hydration, Hydroxylation, Hydroboration, Epoxidation, Carbene addition, Hydrogenation, Ozonolysis. **Ref. 1. Page No. 517-557** **Ref.3, 8, 9, 10 Relevant pages**	10
6	**Elimination reaction** a) E1, E2, E1CB mechanisms, Stereo chemistry of elimination, Elimination versus substitution, anti and syn elimination. b) Dehydrohalogenation, Dehalogenation, Dehydration, Hoffmann and Saytzeff's elimination, Pyrolytic elimination. **Ref. 1. Page No. 466-501** **Ref.3, 4, 8, 9, 10 Relevant pages**	10

References:

1. Organic chemistry, Fifth edition by Staney H. Pine.
2. Organic Chemistry – by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford).
3. Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Forth Edition by Jerry March.
4. A Guide book to Reaction Mechanism in Organic Chemistry–Peter Sykes.
5. Advance Organic Chemistry (Part A and B) –by A. Carey and R.J. Sundherg.
6. Modern methods of organic synthesis – W. Carruthers (Cambridge) .
7. Organic Chemistry: A Brief Course by Robert C. Atkins, Francis A Carey.
8. Organic Reactions & their Mechanisms- P. S. Kalsi.
9. Organic Chemistry- Morrison & Boyd.
10. Stereochemistry conformations and mechanism by P.S. Kalsi

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Apply the fundamental concepts of organic reaction mechanism in theoretical and practical work, may be in academic, research laboratories, and industries.	3
2	Understand the importance and types of organic reactions and their applications.	2
3	Acquire knowledge of important characteristics of organic compounds.	4

CH-190: Industrial Safety and Good Laboratory Practices (30 L, 50 Marks and 2 Credits)		
Course Objectives: To make the students conversant with the 1. This course offers to create awareness about laboratory safety. 2. This course offers to increase alertness about any hazardous handling at workplace. 3. This course offers to increase awareness about personal protective equipment.		
Unit No.	**Name of the Units**	**Lectures**
1	**Hazards and Safety measures** A) History and importance of safety and health in Laboratory - Moral, legal and financial reasons B) Different types of Hazards at workplace handling chemicals - Physical, chemical, biological, allergens, hazards pertaining electrical system - Effect of hazards on health - Where to find Hazard Information - Reading Labels C) Safety Measures: Safe clothing, hair, dangling jewelry, proper responsible attitude, good housekeeping, use of proper PPE, no food in the laboratories.	**06**
2	**Basic of laboratory safety** Personal Protective and other safety equipment and their uses and demonstration, different types of safety goggles, apron, masks, different filters for masks, face shield, full body suit, safety shoes, helmet, breathing apparatus suit, safety belt and ear muffs along with inspection methods. Emergency exit, its location and approach path, periodic inspection fire extinguishers, first aid kit, its contents and need for monitoring. Eye wash fountains and safety showers, fire drill, and chemical accident drills, accident-free days and incentives to follow safety rules, accident recording and investigation for future controls.	**06**
3	**Introduction to industrial safety** Types of fire extinguishers and their method of use, Material Safety Data Sheets (MSDS), Globally Harmonized System (GHS) Signs (http://www.calstatela.ed/univ/ehs/msds.php) Importance and use of current 16 points format, Labels, Pictograms and some of their discrepancies, Globally Harmonized System for Safety Data Sheets (SDS), label changes (2014).	**06**
4	**Laboratory and chemical waste management** Inventory management, storage and disposal, waste classification, hazardous waste, non-hazardous waste, mixed waste, waste disposal, actions required for - chemical spills, mercury spills, injuries, fires, building evacuations, emergency evacuation procedure.	**06**
5	**Good Laboratory Practices (GLP)** Good Laboratory Practices (GLP), introduction and principles of GLP, performance of laboratory studies and calibration using Standard Operating Procedures (SOPs), instrument validation, reagent certification, laboratory notebook maintenance to contemporary standards, maintenance of laboratory records based on instrument and reagent certification, introduction to ISO and NABL accreditation.	**06**

References:

1. L. Moran, T. Masciangioli, Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management, The National Academies Press, Washington, DC, 2010.
2. D. C. Finster, Safety in Academic Chemical Laboratory, Vol. II, ACS Publication, 7th Edition, 2003.
3. OECD Series on Principles of Good Laboratory Practices and Compliance Monitoring, 1997.
4. Handbook of Good Laboratory Practices, TDR, WHO, UNICEF, UNDP, 2009.
5. L. Huber, A Primer for Good Laboratory Practices and Good Manufacturing Practices, Agilent Technologies, 2002.
6. T. Kletz, What Went Wrong, Gulf Professional Publisher, 1998.

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Understand the importance of laboratory safety.	**1**
2	Aware and follow healthy laboratory practices.	**2**
3	Acquire the knowledge about personal protective equipment.	**4**

AC-101: Practicing Cleanliness **(Compulsory; College-level Audit Course; Practical; 2 Credits)**		
Course Objectives (CObs): • To make students aware of Clean India Mission and inculcate cleanliness practices among them.		

	• Awareness program on
	  o Swachh Bharat Abhiyan (Clean India Mission)
	  o Clean Campus Mission
	  o Role of youth in Clean India Mission
	• Cleaning activities inside and surroundings of Department buildings.
	• Tree plantation and further care of planted trees
	• Waste (Liquid/Solid/e-waste) Management, Japanese 5-S practices
	• Planning and execution of collection of Garbage from different sections of University campus
	• Role of youth in power saving, pollution control, control of global warming, preservation of ground water and many more issues of national importance.
	• Cleanest School/Department and Cleanest Hostel contests
	• Painting and Essay writing competitions	

Course Outcomes (CO):
On completion of this course, the student will be able to:

No.	CO	Cognitive level
1	Identify need at of cleanliness at home/office and other public places.	**2**
2	Plan and observe cleanliness programs at home and other places.	**4**
3	Practice cleanliness practices in day-to-day life.	**3**

CH - 210: Physical Chemistry - II (60 L, 100 Marks and 4 Credits)		
Course Objectives: 1. To orient and acquaint the PG students towards the fundamental and advanced aspects of thermodynamics and statistical thermodynamics. 2. To acquire knowledge about kinetics of complex reactions and fast reactions. 3. To evoke the fundamental concepts of YR, electronic and Raman spectroscopy and understand the advance concept involved in it.		
Unit No.	**Name of the Units**	**Lectures**
1	**Thermodynamics** Introduction, enthalpy of a system, molar heat capacities, relation between Cp and Cv, Joule-Thomson effect, third law of thermodynamics, concept and importance of absolute entropy, standard entropy and residual entropy, Maxwell relations (derivation expected), thermodynamic equation of state, partial molar quantity and its significance, partial molar volumes, chemical potential, Gibbs-Duhem equation, thermodynamics of mixing-Gibb's free energy of mixing, entropy of mixing, enthalpy of mixing and related numerical **Ref: 2, 8, 13, 14**	**12**
2	**Statistical thermodynamics** Introduction, Concept of Boltzmann Ensemble, Thermodynamic probability, Sterling approximation, Boltzmann distribution law, partition function and its significance, energy and entropy in terms of partition function, separation of partition functions, translational partition function, translation energy and entropy from it, rotational partition function, rotational energy and entropy from it, vibrational partition function, vibrational energy and entropy from it and related numerical. **Ref:1, 2, 8, 13, 14**	**12**
3	**Chemical kinetics** Introduction, complex reactions, reactions approaching equilibrium (opposing reactions), consecutive elementary reactions (sequential reactions), parallel reactions and its kinetics, elucidation of mechanism of complex reactions: rate determining step of the reaction and steady state approximation, pre-equilibria, Michaelis-Menten mechanism of enzyme catalysis, chain reactions and its characteristics, steps involved in chain reactions with suitable example. Explosion, Types of explosion, explosion limits and related numerical. Fast reactions, techniques for the study of fast reactions: flow methods and flash photolysis. **Ref: 2, 8, 13, 14.**	**12**
4	**Infra-red Spectroscopy** Introduction, the vibrating diatomic molecule, the energy of a diatomic molecule, the simple harmonic oscillator, the anharmonic oscillator, the diatomic vibrating rotator: Born-Oppenheimer approximation, breakdown of Born-Oppenheimer approximation, the vibrations of polyatomic molecules, fundamental vibrations and their symmetry (water molecule and carbon dioxide molecule) and related numerical. **Ref: 8, 11, 14**	**12**

5	**Electronic and Raman spectroscopy** (a) Electronic spectroscopy: Electronic vibrational spectra, intensity of vibrational electronic spectra, Franck-Condon principle, rotational fine structure, Fortrat diagram, dissociation energy, pre-dissociation. (b) Raman Spectroscopy: Introduction, Rayleigh and Raman scattering, quantum theory of Raman effect, classical theory of the Raman effect: Molecular polarizability, Raman activity of vibrations (water molecule and carbon dioxide molecule), rule of mutual exclusion. and related numericals. **Ref: 8, 11, 14.**	**12**

References:

1. Maron, S. H. and Prutton, C. F. (2012) Principles of Physical Chemistry (4th Edition), Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Atkins, P. W. (1998) Physical Chemistry, ELBS.
3. Barrow, G. M. (2003) Physical Chemistry, International Student Edition.
4. Moore, W. J. (1998) Physical Chemistry, Orient Longman.
5. McQuarrie, D. A. And Simon, J. D. (2006) Physical Chemistry- A Molecular Approach, Viva Books Ovt. Ltd., New Delhi.
6. Nash, L. K. (1968) Elementary Statistical Thermodynamics, Addition-Wesley, Reading.
7. Gupta, M. C. (1990) Statistical Thermodynamics, M. C. Gupta, Wiley Eastern Ltd.
8. Laidler, K. J. (1965) Chemical Kinetics, Second Edition.
9. Frost, A. A. and Pearson, R. G. Kinetics and Mechanism, Second Edition.
10. Agrawal, G. L. Basic Chemical Kinetics by Tata McGraw-Hill Publishing Company Ltd., New Delhi.
11. Banwell, C. N. and McCash, E. M. (1996) Fundamentals of Molecular Spectroscopy, McGraw Hill International (UK).
12. Bahl, B. S., Bahl, A., Tuli, G. D. (2005) Essentials of Physical Chemistry by Chand and Co Ltd., New Delhi.
13. Puri, B. R., Sharma, L. R. and Pathania M. S. (2007) Principles of Physical Chemistry (42nd Edition), , Vishal Publishing Co., Jalandhar.
14. Dr. L. S. Patil, Physical Chemistry II, Shree Book Co. Mumbai.

Course Outcomes (CO):

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

No.	CO	Cognitive level
1	Students will gain an understanding of Joule-Thomson effect, third law of thermodynamics, absolute entropy, standard entropy and residual entropy and partial molar quantity and its significance.	**2**
2	Students should understand the importance of statistical thermodynamics and concept of partition functions.	**2**
3	Students should able to understand core study of chemical kinetics and spectroscopy.	**2**

CH - 230: Inorganic Chemistry - II (60 L, 100 Marks and 4 Credits)		
Course Objectives: 1. This course offers to impart the basic knowledge about spectroscopy of inorganic compounds 2. This course also offers to study the reaction mechanism in transition metal complexes. 3. This course helps to understand catalysis and structure reactivity of molecules.		
Unit No.	***Name of the Units***	***Lectures***
1	**The Ionic bond** Structures of ionic solids, radius ratio rules, calculation of limiting radius ratio Values of coordination no.3, 4, 6, close packing, classification of ionic structures – Ionic compounds of the type AX (ZnS, NaCl, CsCl), Ionic compounds of the type AX_2 (CaF_2, TiO_2, SiO_2); Layer structures (CdI_2, [NiAs]) Structures containing polyatomic ions.	**12**
2	**Electronic Spectra** Energy levels in an atom, coupling of orbital angular momenta, coupling of spin angular momenta, spin orbit coupling. Determining the ground state terms – Hund’s rule, Hole formulation, Derivation of the terms for a P2 & P3 configuration, calculation of the number of microstates, Electronic spectra of transition metal complexes – Laporte ‘orbital’ selection rule, spin selection rule, splitting of electronic energy levels and spectroscopic states.	**12**
3	**Reaction mechanism in transition metal complexes** Ligand substitution reaction, classification of mechanism, substitution of square planer complexes, nucleophilicity of entering group, shape of activated complexes, K1 pathway, substitution in octahedral complexes, rate law and their interpretation, activation of octahedral complexes, base hydrolysis, stereochemistry, isomerization reactions.	**12**
4	**Catalysis** Catalysis, description of catalyst, properties of catalyst, types of catalyst, catalytic steps in organotransition metal catalyst, hydrogenation of alkenes, hydroformylation, Monsanto acetic acid synthesis, Wacker oxidation of alkenes, alkene polymerization, heterogeneous catalysis, nature of heterogeneous catalyst, examples of heterogeneous catalysts (hydrogenation, oxidation).	**12**
5	**Preparation & Application of Complexes** Preparation of complexes, Application of complexes in analytical chemistry, complexometric titration, Application of complexes in metallurgy, Application of complexes in industry, Application of complexes in medical field. Presence of metal complexes in biological system (Haemoglobin, Chlorophyll, Vitamin-B_{12})	**12**

References:

1. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry Principles of Structures and Reactivity, 4th edition, New York, NY: Harper Collins College Publishers, 1993.
2. J.D. Lee, Concise Inorganic Chemistry, 5thedn., Blackwell Science, London, 2006.
3. A. G. Sharpe, Inorganic chemistry, 3rd edition, ISBN 9788131706992, Pearson Education,1981.
4. F.A. Cotton, Chemical Applications of Group Theory, ISBN: 978-0-471-51094-9, 1990.
5. D.F. Shrivers, P.W. Atkins and C.H. Lang for, Inorganic Chemistry, CH Langford, 1990.
6. B.R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co.,2005.
7. H. B. Gray, Electrons and Chemical Bonding. W. A. Benjamin, Inc., New York, 1965.
8. H. J. Emeleus and A.G. Sharpe, Modern Aspects of Inorganic Chemistry, Universal Book Stall, New Delhi.
9. K. lal, S.K. Agarwal, Advanced Inorganic Chemistry, Pragati Prakashan, Meerut, 2017.
10. G.S. Manku, Theoretical Principles of Inorganic Chemistry, Tata McGraw-Hill Ed.
11. B. Douglas, D.H. Mc. Daniel, J.J. Alexander, Concepts and Models of Inorganic Chemistry, 2nd edition.
12. R. Sarkar, General and Inorganic Chemistry, Part one, New Central Book Agency, Kolkata.
13. P.K. Bhattacharya, Group Theory and its Chemical applications, Himalaya Publishing House.
14. F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, Advance Inorganic Chemistry, Sixth Edition, JOHN WILEY & SONS, INC.
15. K. Arora, Concept and Applications of Group Theory, Anmol Publication Pvt. Ltd., New Delhi.
16. W. L. Jolly, Modern Inorganic Chemistry, 2nd edition, Tata McGraw Hill Co.

Course Outcomes (CO):

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

No.	CO	Cognitive level
1	Understand the concept of microstates, spectroscopic terms and orgel diagram of inorganic compounds.	**2**
2	Gain knowledge about magnetic properties and charged transfer spectra of transition metal complexes.	**2**
3	Students are able to analyze structure reactivity and reaction mechanisms of metal complexes.	**4**

CH - 250: Organic Chemistry - II (60 L, 100 Marks and 4 Credits)

Course Objectives:

1. This course also offers to learn various name reactions, rearrangement and reagents used in organic chemistry.
2. The course offers to study the importance of stereochemistry and organic spectroscopy for structure elucidation with respect to laboratory and industrial applications.
3. This course helps to understand the principles behind UV, IR, ^{1}HNMR, ^{13}CNMR and Mass spectroscopy.

Unit No.	Name of the Units	Lectures
1	**Rearrangements** Wagner-Meerwein (with Demjanov), Pinacol, Wolff, Arndt-Eistert Synthesis, Hofmann, Curtius, Schmidt, Lossen, Beckmann, Baeyer-Villiger, Favorskii, Benzilic acid, Stevens, Wittig, Claisen, Cope, oxy-cope, Meisenheimer, Sommelet-Hauser, Dienone-phenol, Ciamician-Dennsted, Fries (with photo Fries) rearrangements	12
2	**Selective Name Reactions** Aldol Condensation, Henry reaction, Perkin reaction, Stobbe Condensation, Dieckmann Condensation, Benzoin Condensation, Reimer-Tiemann reaction, Reformatsky reaction, Darzens reaction, Michael reaction, Mannich reaction, Shapiro reaction, Bomford-Stevens reaction, Nef reaction, Baylis Hilman reaction, Cannizaro reaction, Knovengeal reaction, Sharpless reaction, Barton reaction, Hofmann Loffler-Freytag reaction, Vilsmeir-Haack reaction	14
3	**Reagents in Organic Synthesis** **A] Oxidizing Reagent:** CrO_3, $Na_2/K_2Cr_2O_7$, Collins reagent, PDC (Cornforth reagent), PCC (Corey's reagent), $KMnO_4$, MnO_2, SeO_2, $Pb(OAc)_4$, Pd-C, OsO_4, Peracid, (m-CPBA), O_3, H_2O_2, $NaIO_4$, HIO_4, $Al(O\text{-}i\text{-}R)_3$ (Oppenauer oxidation), Swern oxidation, DDQ, NBS and B_2H_6 **B] Reducing Reagent:** $LiAlH_4$, $NaBH_4$, $NaCNBH_3$, MPV reduction, Na/liquor NH_3, Na/alcohol, H_2/Pd-C, H_2/Pd-$BaCO_3$, DIBALH and Wolff Kishner reduction, Zn-Hg/H_2O/HCl, Zn(Cu), Baker's yeast, LDC (Gilman's reagent), LDA (Lithium diisopropylamide), DCC (dicyclohexylcarbodimide), Woodward and Prevost hydroxylation and Baker's yeast.	14
4	**Stereochemistry** Stereochemical principles (stereoisomers, chirality, optical activity, enantiomers, diastereoisomers, epimer, anomer), R-S nomenclature, Meso Compounds, E-Z nomenclature, Threo and Erythro nomenclature. optical activity in biphenyls, spiranes, allenes, Racimic modification and racimation, optical purity, pro-stereoisomerism (Homomorphic, Homotopic, Heterotopic, enantiotropic, diastrophic-atoms, groups and faces). Interconversion of Fischer, Newman and Sawhorse Projections, stereospecific and stereoselective reactions Conformational analysis of cyclic (cyclohexane, mono-substituted cyclohexane) and acyclic compounds (ethane, propane, butane).	14

5	**Spectroscopy:** Instrumentation, Sample Preparation for UV, IR, NMR (^{1}H and ^{13}C), Mass Spectrometry. Joint problems based on UV, IR, NMR (^{1}H and ^{13}C), Mass.	**06**

References:

1. S. H. Pine – Organic Chemistry, 5th Edition, McGraw-Hill.
2. P. S. Kalsi – Organic Reactions and Their Mechanisms
3. J. Clayden, N. Greeves, S. Warren – Organic Chemistry, IInd Edition, Oxford University Press.
4. Peter Sykes-A Guidebook to Mechanism in Organic Chemistry
5. W Carruthers and Iain Coldham – Modern Methods of Organic Synthesis
6. P. S. Kalsi –Stereochemistry: Conformation and Mechanism, 8th Edition, New Age International.
7. F. A. Carey, R. J. Sundberg – Advanced Organic Chemistry Part-B: Reactions and Synthesis, 5th Edition, Springer.
8. D. Nasipuri – Stereochemistry of Organic Compounds: Principles and Applications, Revised 2ndEdition, New Age International.
9. E. L. Eliel – Stereochemistry of Carbon Compounds, McGraw-Hill.
10. P. S. Kalsi – Spectroscopy of Organic Compounds, 6th Edition, New Age International.
11. D. L. Pavia, G. M. Lampman, G. S. Kriz, J. R. Vyvyan – Introduction to Spectroscopy.
12. R. M. Silverstein, F. X. Webster – Spectrometric Identification of Org. Compounds.

Course Outcomes (CO):

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

No.	CO	Cognitive level
1	Students will learn the basic name reactions and rearrangement reactions.	**2**
2	Students will understand the applications of reagents in organic synthesis.	**2**
3	Students will apply the basic knowledge about core study of spectroscopy and stereochemistry	**3**

CH - 290: Instrumentation and Analysis (30 L, 50 Marks and 2 Credits)		
Course Objectives: 1. This course covers both fundamental and practical aspects of chemical analysis. 2. The student will learn about instrumentation, working and applications in chemistry. 3. This course also covers solving numerical problems.		
Unit No.	**Name of the Units**	**Lectures**
1	**Errors, statistics and sampling:** Accuracy and precision, Error, types of error, systematic and random errors, minimization of errors, mean and standard deviations, reliability of results, confidence interval, comparison of results, student T test, F test, Comparison of two samples (Paired T test), correlation and regression, correlation coefficient and liner regression, Sampling, the basis of sampling, sampling procedure and sampling statistics.	**06**
2	**Voltammetry:** Excitation signals Linear-sweep Voltammetry- voltammetric instruments, voltammetric electrodes, voltammograms, hydrodynamic voltammetry and voltammetric detectors.	**06**
3	**Electrogravimetric Analysis:** Theory of electrogravimetric analysis, terms used in electrogravimetric analysis, completeness of deposition, Electrolytic separation of metals, character of the deposit, electrolytic separation of metals with controlled cathode potential, apparatus and determination of copper (constant current procedure).	**06**
4	**Ultra-purity and ultra-trace analysis:** Ultra-purity and ultra-trace analysis, laboratory dosing, purification of reagents, Preconcentration Techniques and contamination control during analytical operation.	**06**
5	**Chemical Aspects to Nanomaterials:** Nanoscience and nanotechnology, effect of making into small size, general theme of classification of nanomaterial, application of nanomaterials, characterization of nanomaterials using XRD, SEM-EDAX, and TEM.	**06**

References:

1. H. H.; Willard, L. L. Merritt, J. A. Dean, F. A. Settle, Jr. Instrumental Methods of Analysis.
2. G. R. Chattwal and S. Anand, Instrumental Methods and Chemical Analysis.
3. D. A. Skoog and D. M. West, Fundamentals of Analytical Chemistry", 4th Ed., CBS College, Publishing, New York.
4. Vogel's Text Book of Quantitative Chemical analysis (Sixth Edition) By- J.
5. Mendham, R.C. Denny, J.D. Barnes, M.J.K. Thomas (Pearson Education- Low Price Edition)

Course Outcomes (CO):

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

No.	CO	Cognitive level
1	Explain various theoretical concepts of analytical chemistry.	**2**
2	Build up ability to solve the numerical problems.	**3**
3	Apply theoretical principles, working of various classical and modern instrumentation techniques.	**3**

AC-201(A): Soft Skills (Personality and Cultural Development Related Audit course; Practical; 2 Credits)		
	Course Objectives (CObs): • To develop soft skills and communication skills amongst the students.	
1	**Introduction to soft skills** Formal definition, Elements of soft skills, Soft vs. Hard skills, Emotional quotient, Goal setting, life skills, Need for soft skills, Communication skills, Etiquettes& Mannerism.	**2 h**
2	**Self-Assessment** Goal setting, SWOT analysis, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements, positive attitude, positive thinking and self-esteem. Activity: The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.	**4 h**
3	**Communication Skills** Types of communication: Verbal, Non-verbal, body language, gestures, postures, gait, dressing sense, facial expressions, peculiarity of speaker (habits). Rhetoric speech: Prepared speech (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver, Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic), Storytelling (Each student narrates a fictional or real-life story for 5 minutes each), Oral review (Each student orally presents a review on a story or a book read by them) Drafting skills: Letter, Report & Resume writing, business letters, reading & listening skills Activity: The teacher should teach the students how to write the letter, report and build resume. The teacher should give proper format and layouts. Each student will write one formal letter, one report and a resume.	**8 h**
4	**Formal Group Discussion, Personal Interview & Presentation skills** Topic comprehension, Content organization, Group speaking etiquettes, driving the discussion & skills. Preparation for personal interview: dress code, greeting the panel, crisp self-introduction, neatness, etiquettes, language tone, handling embarrassing & tricky questions, graceful closing. Activity: Each batch is divided into two groups of 12 to 14 students each. Two rounds of GD for each group should be conducted and teacher should give them feedback. Mock interviews to be conducted.	**4 h**
5	**Aptitude and analytical skills** Quantitative aptitude, Numerical reasoning, verbal reasoning, diagrammatic test, situational tests, logical thinking. Analytical skills: Definition, Types, problem solving	**8 h**
6	**Life skills** Time management, critical thinking, sound and practical decision making by dealing with conflicts, stress management, leadership qualities Activity: The teacher can conduct a case study activity to train students for decision making skills. The teacher should conduct a session on stress management and guide students on how to manage stress. The teacher may conduct a stress relieving activity in the class. He/she may counsel students individually to know their problems and guide them on dealing with them effectively.	**4 h**

Suggested readings:

1. Basics of Communication In English: Francis Sounderaj, MacMillan India Ltd.
2. English for Business Communication: Simon Sweeney, Cambridge University Press
3. An Introduction to Professional English and Soft Skills: Das, Cambridge University Press
4. Quantitative Aptitude: R.S. Agrawal

Course Outcomes (CO):

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

No.	CO	Cognitive level
1	Grasp soft skills and communication skills.	**2**
2	Apply life skills to manage the situations.	**4**

CH-P-1: Physical Chemistry Practical-I
(180 Hrs., 100 Marks and 6 Credits)

Course Objectives: The practical course is designed

1. To understand the basic principles of different techniques used in laboratory and provide hands on training on various instruments.
2. To understand the standardization of instruments to make appropriate measurements, analyze the data and report the results.
3. To understand the basic principles of different techniques used in laboratory.
4. to develop the experimental skills in physical chemistry
5. To acquire the knowledge about verification of theoretical aspects.
6. To understand the standardization of instruments like colorimeter, polarimeter etc. and their application.

Students should perform minimum of twenty (20) experiments.
It is expected to perform at least two experiments from each technique.

INSTRUMENTAL

Conductometry

1. Determine the conductance of strong electrolyte (KCl/NaCl/$AgNO_3$/HCl) at various concentrations and verify the applicability of DHO equation.
2. Determine the amount of trichloroacetic acid, monochloroacetic acid and acetic acid in the given by conductometric titration against sodium hydroxide solution.
3. Determine the solubility of sparingly soluble salt ($BaSO_4$) at different temperatures conductometrically and determination of ΔG, ΔH and ΔS of the solution.
4. Study the second order velocity constant of hydrolysis of ethyl acetate by sodium hydroxide using conductance measurement.
5. Determination of critical micellar concentration (CMC) of sodium lauryl sulphate from the measurement of conductivities at different concentrations.
6. To determine the concentration of Fe^{2+} ions by titrating with potassium dichromate solution conductometrically.

Potentiometry

1. To determine the stability constant of a complex ion $[Ag_2(S_2O_3)]^{-3}$ potentiometrically.
2. To determine standard free energy change ΔG^0 and equilibrium constant for the reaction $Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$ potentiometrically.
3. To determine the activity coefficient of an electrolyte (HCl) by potentiometry.
4. To determine the amount of each halide in a mixture of halides containing a) KI and KBr/KCl or b) KI / KBr and KCl potentiometrically.
5. To titrate ferrous ammonium sulphate solution with potassium dichromate solution potentiometrically using bimetallic electrode pair.
6. To determine the transport number of Ag^+ and NO_3^- ion.

pH metry

1. Determination of Hammette constant of a given substituted benzoic acid by pH measurements.
2. To determine acidic and basic dissociation constant of amino acid and the iso-electric point of the acid.
3. To determine the three dissociation constants of polybasic acid such as H_3PO_4 by pH measurements.
4. Determine the effect of KCl on the pH of HCL solution.

Colorimetry / Spectrophotometry

1. To determine the pKa and Ka of given indicator by colorimetry / spectrophotometry
2. To determine the empirical formula of Ferric salicylate complex by Job's method and verify by slope ratio method.
3. Determine the amount of Cu (II) and Fe (III) in a mixture by titrating it against standard EDTA solution spectrophotometrically.
4. Determination of iron in water using a colorimeter.
5. Simultaneous determination of $Cr_2O_7^{2-}$ and MnO_4^- ions or Co^{2+} and Ni^{2+} in the solution by spectrophotometry.
6. Record the UV spectrum of Benzene, Pyridine and Pyrimidine in methanol. Compare and discuss the various transition involved in terms of MO theory.

Polarimetry

1. Polarimetric determination of the specific rotation of camphor in benzene and carbon tetrachloride.
2. Determine the percentage of two optically active substances (d-glucose and d-tartaric acid) in a mixture polarimetrically.

Refractometry

To measure refractometrically average polarizability of some of the common solvents.

NON-INSTRUMENTAL

Chemical Kinetics

1. To determine the rate constant for depolymerization of diacetone alcohol catalysed by sodium hydroxide using dilatometer.
2. Study the kinetics of reaction between potassium persulphate and potassium iodide.
   a) Determine the rate constant.
   b) Study the influence of ionic strength on the rate constant.
3. To determine energy of activation of the hydrolysis of methyl acetate in presence of hydrochloric acid (Calculations and graphs expected from excel programming)
4. Determine the colorimetrically the order and energy of activation for decomposition of violate coloured complex of ceric ion and N-phenylanthranilic acid.

Other Non-instrumental experiments

1. Determined the transport number of H^+ and Cl^- ions by moving boundary method.
2. To obtain solubility curve for liquid say water-acetic acid-chloroform system
3. Investigate the adsorption of acetic acid in aqueous solution by using activated charcoal and verify Freundlich's adsorption isotherm.
4. Determination of partial molar volume of ethanol in dilute aqueous solutions.
5. To study the effect of addition of an electrolyte ($KCl/NaCl$ /NH_4Cl/Na_2SO_4 / K_2SO_4) on solubility of an organic acid (benzoic acid or salicylic acid).

Cryoscopy:-

To determine the mean activity coefficient of an electrolyte (NaCl) in dilute solution by cryoscopic measurement.

References:

1. Findley's Practical Physical Chemistry (9th edition), Edited by B. P. Levitt (Longman Group Ltd).
2. Systematic Experimental Physical Chemistry (2nd edition), By S. W. Rajbhoj and Dr. T. K. Chondekar (Anjali Publication, Aurangabad).
3. Advanced Practical Physical Chemistry (26th edition), By J. B. Yadav (Goel Publishing House, Meerut).
4. Experimental Physical Chemistry, By V. D. Athawale, P. Mathur (New Age international Ltd, New Delhi)
5. Advanced Practical in Physical Chemistry (13th edition or latest) By Dr. Pande, Dr. Mrs. Datar, Dr. Mrs Bhadane, Manali Publication, Pune.
6. University Practical Chemistry by P. C. Kamboj, Vishal Publishing Co. Jalandhar, Panjab.
7. Practical Physical Chemistry, By A. M. James and F. F. Prichard, Longman Group Ltd.
8. Advanced Physical Chemistry Experiments by Dr. J. N. Gurtu and Amit Gurtu, Pragati Prakashan Meerut.

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Students will understand the preparation for each experiment.	**2**
2	Setup and standardize the potentiometer, P^H meter and conductometer.	**3**
3	Identify thermodynamics and kinetics of simple systems.	**4**
4	To know Safety requirements and lab skills to perform physico-chemical experiments.	**2**
5	To apply the principles and techniques to different systems.	**3**

CH-I-1: Inorganic Chemistry Practical-I (180 Hrs., 100 Marks and 6 Credits)
Course Objectives: The practical course is designed 1. To understand the basic principles of different techniques used in laboratory analysis. 2. To provide hands on training on various techniques of analysis. 3. Develop the ability to analyze drug samples 4. To make appropriate measurements, analyze the data and report the results.
Students should perform minimum of twenty (20) experiments.
Analysis of ore (minimum two) a. Pyrolusite ore - Estimation of silica gravimetrically and Manganese volumetrically. b. Haematite - Estimation of copper volumetrically and Iron gravimetrically. c. Chromite ore – Estimation of Iron gravimetrically and chromium volumetrically.
Analysis of binary mixtures by gravimetric and volumetric method (minimum five) a) Copper- Nickel b) Copper -Magnesium b) Copper-Zinc c) Iron-Magnesium d) Nickel-Zinc e) Lead-Tin
Drug Analysis (minimum one) a. Determination of iron from given drug sample. b. Determination of Calcium from given Calcium tablet.
Thermochemistry (minimum two salts) To determine the lattice energy of binary salts (NaCl, KCl, $CaCl_2$).
Preparation of the following complexes and determination of its purity (minimum four) a) Potassium trioxalatoferrate(III)trihydate b) Tris(acetylacetonato)iron(III) c) Potassium di aqua bis(oxalato) chromate (III) d) Prussian Blue (Potassium Ferric Ferro cyanide) e) Chloropenta-amminecobalt (III) chloride
Chromatography (minimum two) a) Determination of the Rf value of Pb, Cu, Cd ions by using paper chromatographic technique. b) Determination of the Rf value of Fe, Al, Cr ions by using paper chromatographic technique. c) Determination of the Rf value of Ba, Sr, Ca ions by using paper chromatographic technique.
Instrumental method of Analysis (minimum four experiment) a) To determine the strength of given mixture of carbonate and bicarbonate by pH metric method b) To determine Ca in the given solution by flame photometrically, by calibration curve Method**.**

c) Spectrophotometry (**any one**)

1. Estimation of phosphate from waste water by calibration curve method
2. Estimation of Manganese from steel.

d) To determine the amount of copper present by iodometric method (potentiometrically)

e) Estimation of Boric acid using NH_4OH by conductometric method.

References:

1. A Text book of Quantitative Analysis by A.I.Vogel , 4**th** edition
2. Advanced Practical Inorganic Chemistry By Gurdeep Raj Goel Publishing House.
3. Post Graduate Practical Chemistry (Part – 1) by H.N. Patel, S.P. Turakhia,S.S. Kelkar, S.R. Puniyani, Himalaya Publishing House.
4. Applied Analytical Chemistry: Vermani.
5. University Practical Chemistry by P.C.Kamboj
6. Commercial Methods of Analysis: Shell &Biffen

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Students will understand the process of ore analysis.	**2**
2	Students able to apply their knowledge for binary mixture separation of inorganic compounds using quantitative analysis	**3**
3	Students can analyze contents present in drug	**4**
4	Students able to evaluate the lattice energy of binary salt	**6**
5	Students are able to synthesize and evaluate the complex and also able to determination of complex purity.	**5**
6	Students understand the techniques of chromatography and its application in analysis.	**2**
7	Students able to handle and perform the instrumental analysis techniques.	**3**

CH-O-1: Organic Chemistry Practical-I (180 Hrs., 100 Marks and 6 Credits)
Course Objectives: The practical course is designed 1. To make students aware of how to perform organic compounds in laboratory. 2. The course includes synthesis of some derivatives and organic compounds, which will help them while working in research laboratory in future. 3. This course will help them in industry or while doing research in medicinal chemistry for Drug development. 4. To make student aware of green chemistry and role of green chemistry in pollution reduction and pollution control. 5. The students learn how to avoid solvents and do solvent free reaction. 6. Also, the work-up procedure in many experiments is made more eco-friendly to environment.
Introduction to Laboratory Safety (Minimum 2 Practical) • Meaning of safety signs on container of chemicals, safety handling of chemicals • Handling of glassware's and care to be taken, handling of organic flammable as well as toxic solvents in laboratory, • Use of Personal Protective Equipment (PPE) (safety goggles, shoes and gloves) • Fire extinguisher and its use, • Chemical Spills/Clean up: action to be taken in accidental cases e.g. cleaning of acid spill over, use eye wash station and bath station in emergency, etc. (compulsory) • Behaviour: No food or drink policy; include information about where food and drink are allowed (if such a space exists). Explicitly state that disruptive or destructive behaviour will not be tolerated.
Single Stage Preparation Monitored by TLC (Minimum 6) 1. Acetophenone to Benzalacetophenone. 2. Resorcinol to 7-hydroxy, 4-methyl coumarin. 3. Camphor to Borneol. 4. Benzophenone to Benzhydrol. 5. Acetoacetic ester to Pyrazolone. 6. Paramino Benzoic Acid to Parachloro Benzoic Acid. 7. 2-methoxy naphthalene to 1- formyl-2-methoxy napthalene. 8. Gycine to Benzoylglycine. 9. p- nitrotoluene to p- nitrobenzoic acid. 10. Fischer Indole Synthesis-Reaction of phenyl hydrazine and cyclohexanone 11. Knoevenagel condensation reaction-Reaction of aldehyde and malononitrile. 12. Anthracene to Anthraquinone 13. Benzaldehyde to Cinnamic acid 14. Anisole to 2,4-Dinitroanisole
Purification Techniques (Minimum 8 Demonstration/Experiments) 1. Purification of two organic solids by recrystallization using solvents other than water 2. Purification of two organic liquids by upward/downward/traditional distillation technique 3. Column Chromatography technique should be performed for any one of the above

preparations
4. Purification by Sublimation Method
5. Thin Layer Chromatography technique for identification of two different compounds present in mixtures
6. Solvent extraction using Soxhlet extractor.
7. Solvent extraction by separatory funnel
8. Steam distillation.

Use of Chemistry software's like, ISI draw, Chem Draw, Chem Sketch (Minimum 4)

2. Draw the structure of simple aliphatic and aromatic compounds, heterocyclic compounds with different substituent. (Minimum Ten Compounds).
3. IUPAC name and predict the NMR Signals.
4. Sketch Design reaction mechanism scheme of any two addition and two substitution reactions.
5. Literature Search and references.

Preparation of Derivatives: (Minimum 6)

1. Acetyl
2. Benzoyl
3. Semicarbazone,
4. Amide
5. Aryloxyacetic acid,
6. Ester
7. Oxime

Introduction to Green Chemistry

Concept of green chemistry, twelve principals of green chemistry, applications of green chemistry for sustainable development, Atom economy.

Green Chemistry Preparations (Minimum 4)

1. Bromination of acetanilide using Cerric ammonium nitrate.
2. Preparation of Benzilic Acid using NaOH /KOH under Solvent-free Conditions.
3. Photo reduction of benzophenone to benzopinacol in presence of sun light using isopropanol and acetic acid.
4. Nitration of salicylic acid
5. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature.
6. Alternative Green Procedure for Preparation of a Derivative for Carboxylic Acid.
7. Alternative Green Procedures for Organic Qualitative Analysis - Detection of N, S, Cl, Br, I.

Interpretation of UV, FT-IR and ^{1}H-NMR spectrum of above synthesized compounds. (Minimum 10 Compounds)

References:

1. A text book of practical organic chemistry- A. I. Vogel.

2. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal
3. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
4. R. K. Bansal, Laboratory Manual of Organic Chemistry, New Age International Publisher

Course Outcomes (CO):

After successful completion of the course students are expected to

No.	CO	Cognitive level
1	Students understand the important of safety techniques and handling of chemicals.	**2**
2	Students are made aware of carrying out different types of reactions and their workup methods.	**2**
3	Students able to perform purification techniques in organic chemistry like recrystallization, distillation, steam distillation and extraction.	**3**
4	This practical course is designed to make student aware of green chemistry and role of green chemistry in pollution reduction.	**5**
5	Students are able to apply their knowledge for development of experiment involve green chemistry.	**6**

AC-201(B): Practicing Sports Activities (Personality and Cultural Development Related Audit course; Practical; 2 Credits)
Course Objectives (CObs): • To motivate students towards sports and provide them required training.

SR NO.	NAME OF THE SPORT/GAME (Select ONE of the Following)	SYLLABUS OF THE COURSE	TIMING (02 Hours in a Week)	SEMESTER
1	Volleyball	• General Fitness • Basic Fitness • Specific Fitness • History of the Game • Basic Skill of the Game • Major Skill of the Game • Technique & Tactics of the Game • Game Practice	Morning : 07 to 09 AM OR Evening : 05 to 07 PM	Total 30 Hours in Each Semester
2	Athletics			
3	Badminton			
4	Cricket			
5	Basketball			
6	Handball			
7	Kabaddi			
8	Kho-Kho			
9	Table-Tennis			
10	Swimming			

Course Outcomes (CO):
On completion of this course, the student will be able to:

No.	CO	Cognitive level
1	Play any sports on the ground.	**2**
2	Become healthier and fit.	**3**

AC-201(C): Practicing Yoga

(Personality and Cultural Development Related Audit course; Practical; 2 Credits)

Course Objectives:

- To motivate students towards yoga and provide them required training.

- Yog: Meaning, Definition & Introduction, Objectives
- Primary Introduction of Ashtanga Yoga
- Preparation of Yogabhyas
- Omkar Sadhana, Prayer, Guru Vandana
- Sukshma Vyayamas
- Suryanamaskar (12 Postures)
- Asanas :
  - Sitting (Baithaksthiti) - Vajrasana, Padmasan, Vakrasan, Ardha-Pashchimotanasanan
  - Supine (Shayansthiti) - Uttan Padaasan(Ekpad/Dwipad), Pavanmuktasana, Viparitakarani Aasan, Khandarasan, Shavasana
  - Prone (Viparitshayansthiti) - Vakrahasta, Bhujangasana, Saralhasta Bhujangasana, Shalabhasana(Ekpad/Dwipad), Makarasana
  - Standing (Dhandsthiti) - Tadasana , TiryakTadasana, Virasana, Ardh Chakrasana
- Primary Study of Swasana: Dirghaswasana, Santhaswasana, JaladSwasana - 6 Types
- Pranayama : Anuloma-viloma, Bhramari

Course Outcomes (CO):

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

No.	CO	Cognitive level
1	Perform different yoga.	**2**
2	Perform different asanas.	**3**

AC-201(D): Introduction to Indian Music (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional: Campus-level)	
	Course Objectives: • To motivate students towards Indian music and provide them minimum required training. .
	• Definition and brief about generation of Swar, Saptak, Thaat, Raag, Aavartan, Meend, Khatka, Murkee, Taal, Aalaap etc. • Taal and its uses - Treetaal, Daadraa, Zaptaal, Kervaa. • Information of Badaakhyaal, Chhotaakhyaal (one), Sargam, Lakshangeet (information) • Detailed information of Tambora • Detailed information of Harmonium and Tablaa. • Five filmy songs based on Indian Classical Music (Theory and Presentation) • Sound Management - Basic information of Sound Recording (including Practicals) • Composition of Music as per the Story • Preparing news write-ups of the Seminars, Library Musical Programmes held at the nearest Akashwani, by personal visits.

Course Outcomes (CO):
On completion of this course, the student will be able to:

No.	CO	Cognitive level
1	Identify different types of Indian music.	**3**
2	Develop more interest to learn and practice Indian music.	**4**

KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY,
JALGAON

Academic Curriculum
(For Affiliated Colleges of KBCNMU)

MASTER OF SCIENCE
In
ORGANIC CHEMISTRY
PART- II

(Semester III and IV)

Choice Based Credit System, 60:40 Pattern
(Outcome Based Curriculum)

As per UGC Guidelines

w. e. f. 2022-23

2022

KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON

Summary of Distribution of Credits under CBCS Scheme
for
M.Sc. Organic Chemistry
at

[Affiliated Colleges of Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon w.e.f. 2022-23]

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	**12**	**12**	**12**	**08**
02	Core Skill based	**02**	**20**	**-**	**12**
03	Elective	**-**	**-**	**04**	**04**
04	Project	**-**	**-**	**-**	**06**
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**16**	**34**	**18**	**32**

Subject Type	Core	Core Skill based	Elective	Project	Audit	Total
Credits	**44**	**34**	**08**	**06**	**08**	**100**

Total Credits = 100

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Part-II Organic Chemistry (Sem-III and IV)
Choice Based Credit System (Outcome Based Curriculum)
[At Affiliated Colleges w.e.f. 2022-23]

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	3	12	**12**	1	2 + 0	02	1	2	2	**16**
II	3	12	**12**	4	2 + 18	20	1	2	2	**34**
III	3	12	**12**	1	4 + 0	04	1	2	2	**18**
IV	2	08	**08**	4	4 + 18	22	1	2	2	**32**
Total Credits	**44**			**48**			**8**			**100**

(T, Theory; P, Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	**Prerequisite and Core Courses**									
	Theory	14	4	14	4	12	3	08	2	48
	Practical	-	-	18	3	-	-	18	3	36
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	-	-	-	-	4	1	4	1	08
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1							2
2	Personality and Cultural Development Related Course			2	1					2
3	Technology Related + Value Added Course					2	1			2
4	Professional and Social + Value Added Course							2	1	2
	Total Credit Value	16	5	34	8	18	5	32	7	100

List of Audit Courses (Select any ONE course of Choice from Semester II; Semester III and Semester IV)							
Semester I (Compulsory)		**Semester II** (Choose One)		**Semester III** (Choose One)		**Semester IV**(Choose One)	
		Personality and Cultural Development		**Technology + Value Added Course**		**Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Practicing Sport Activities	AC-301B	Cyber Security	AC-401B	Seminar on Review of Research Paper
		AC-201C	Practicing Yoga	AC-301C	Molecular Docking	AC-401C	Current Affairs
		AC-201D	Introduction to Indian Music	AC-301D	Technical Report Writing	AC-401D	Intellectual Property Rights (IPR)

Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon
M. Sc. Part-II Organic Chemistry (Sem-III and IV)
Choice Based Credit System (Outcome Based Curriculum)

Semester-III

Course Code	Course Type	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CH-350	Core	Organic Reaction Mechanism	04	--	04	40	--	60	--	100	--	04
CH-351	Core	Spectroscopic Methods in Structure Determination	04	--	04	40	--	60	--	100	--	04
CH-352	Core	Organic Stereo Chemistry	04	--	04	40	--	60	--	100	--	04
CH-353	Elective	Choose one out of two CH-353 A/B (A) Heterocyclic Chemistry (B) Green Chemistry	04	--	04	40	--	60	--	100	--	04
AC-301 (A)/ (B)/(C)/(D)	Audit Course	Choose one out of four (AC-301 A/B/C/D) (Technology + Value Added Course)	02	--	02	100	--	--	--	100	--	02

List of Audit courses to be offered in Semester-III:

AC-301 (A): Computer Skills **AC-301 (B): Cyber Security**

AC-301 (C): Molecular Docking **AC-301 (D): Technical Report Writing**

Semester-IV

Course Code	Course Type	Title of the Course	Contact hours/week			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
CH-450	Core	Chemistry of Natural Products	04	--	04	40	--	60	--	100	--	**04**
CH-451	Core	Synthetic Methods in Organic Chemistry	04	--	04	40	--	60	--	100	--	**04**
CH-452	Elective	Choose one out of two CH-452 A/B (A) Drug Chemistry (B) Applied Organic Chemistry	04	--	04	40	--	60	--	100	--	**04**
*CH-O-2	Core Skill base	Organic Chemistry Practical Course-II	--	12	12	--	40	--	60	--	100	**06**
*CH-O-3	Core Skill base	Organic Chemistry Practical Course-III	--	12	12	--	40	--	60	--	100	**06**
*CH-O-4	Core Skill base	A Short Research Project	--	12	12	--	40	--	60	--	100	**06**

AC-401 (A)/ (B)/(C)/ (D)	Audit Course	Choose one out of four (AC-401 A/B/C/D) (Professional & Social + Value Added Course)	02	--	02	100	--	--	--	100	--	**02**

* To be started from Semester-III & evaluated at the end of Semester-IV

List of Audit courses to be offered in Semester-IV:

AC-401 (A): Human Rights
AC-401 (B): Seminar on Review of Research Paper
AC-401 (C): Current Affairs
AC-401 (D): Intellectual Property Rights

KAVAYITRI BAHINABAI CHAUDHARI

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus for M.Sc. Part-II Organic Chemistry

(Semester - III & IV) (With Effect from 2022-23)

Course Structure for Second Year

The following will be the structure for revised syllabus from June 2022 for Semester III and Semester IV.

Course Code	Course Type	Title of the Course
		SEMESTER - III
CH-350	Core	Organic Reaction Mechanism
CH-351	Core	Spectroscopic Methods in Structure Determination
CH-352	Core	Organic Stereochemistry
CH-353	Elective	Choose one out of four (CH-353 A/B/C/D) (A) Heterocyclic Chemistry (B) Green Chemistry
AC-301 (A)/(B)/(C)/(D)	Audit Course	Choose one out of four (AC-301 A/B/C/D) (Technology + Value Added Course) AC-301 (A): Computer Skills AC-301 (B): Cyber Security AC-301 (C): Molecular Docking AC-301 (D): Technical Report Writing
		SEMESTER - IV
CH-450	Core	Chemistry of Natural Products
CH-451	Core	Synthetic Methods in Organic Chemistry
CH-452	Elective	Drug Chemistry
*CH-O-2	Core Skill base	Organic Chemistry Practical Course-II
*CH-O-3	Core Skill base	Organic Chemistry Practical Course-III
*CH-O-4	Core Skill base	A Short Research Project
AC-401 (A)/(B)/(C)/(D)	Audit Course	Choose one out of four (AC-401/402/403/404) (Professional & Social + Value Added Course) AC-401 (A): Human Rights AC-401 (B): Seminar on Review of Research AC-401 (C): Current Affairs AC-401 (D): Intellectual Property Rights

Important Notes:

1. Each theory course prescribed for M. Sc. should be covered in 4 lectures, each of 60 minutes duration per week per course including lectures, tutorials, seminars, classroom discussions etc. (Total 60 hrs / theory course)
2. Out of the 60 lectures in each course about 10 lectures will include tutorials, student seminars, classroom discussions and tests.
3. Each practical course will require 12 hours of laboratory work per week per semester and will be extended over two semesters. All three practical courses will be examined at the end of the academic year. (Total 180 hrs / practical course)
4. There should not be more than 10 students in a batch for M. Sc. Practical course.
5. For theory course the question paper (Internal/External) should include numerical, short answer, long answer, MCQ questions to test understanding of subject.
6. The marks for each paper are distributed as external examination 60 marks and internal examination 40 marks. For internal assessment of each theory and practical course, 2 written tests will be taken.
7. The 80 % attendance of students is compulsory.
8. Students should visit at least two chemical industries in two years of M. Sc. and submit the observations/report to the Department.
9. The duration of practical examination will be of six hours.
10. At the time of examination of the **CH-O-4** (A Short Research Project) Viva-voce, the internal and external examiner should be a research guide recognized by the university.

Semester-wise Course Structure of M.Sc. Organic Chemistry

Program at a Glance

Name of the program (Degree)	: M. Sc. (Organic Chemistry)
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60: 40 (60 marks University exam and 40 marks continuous internal departmental exam/assessment)
Passing standards	: 40% in each exam separately (Separate head of passing)
Evaluation mode	: CGPA
Total Credits of the program	: 100 (50 core credits including 6 credits of project/dissertation, 34 skills enhancement credits, 08 subject elective credits and 08 audit credits)

Program Objectives for M.Sc. Program:

1. To impart the profound theoretical and practical knowledge of the specific science discipline along with the fundamental core concepts
2. To train the students to employ modern techniques, tools, methodologies, equipment, hardware/software etc. to perform objective oriented scientific and planned experiments.
3. To groom the students for all-round development and mould them in a trained workforce to provide teaching-learning, research, business, professional supports in the various science disciplines.
4. To make the student to develop the ability to think analytically, independently and draw logical conclusions to solve real-life problems.
5. To utilize the skills and knowledge gained through the subject to deal with real life situations and problems related to society, environment, research and development etc.

Program Outcomes (PO) for M.Sc. Program:

Upon successful completion of the M.Sc. program, student will be able to:

PO No.	PO	Cognitive level
PO1	Understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their irrelevances in the day-to-day life.	**2**
PO2	Administer the skills in handling scientific instruments, planning and performing in laboratory experiments	**3**
PO3	Analyze the given scientific experimental data critically and systematically and the ability to draw the objective conclusions.	**4**
PO4	Develop various skills such as communication, managerial, leadership, entrepreneurship, teamwork, social, research etc., which will help in expressing ideas and views clearly and effectively	**3**
PO5	Model and formulate the real problems and find solution based-on knowledge acquired	**6**
PO6	To evaluate how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.	**5**

Program Specific Objectives for M.Sc. Organic Chemistry program:

- Determine molecular structure by using UV, IR, NMR and Mass.
- Draw mechanism for organic reactions.
- Learn the basic skills of research.
- To learn chemistry of natural products and drugs.
- Study of stereo-chemical aspects of organic reactions.
- Design the organic synthesis using retro synthesis and synthetic catalyst/reaction.
- To get laboratory skills of organic synthesis.

Program Specific Outcomes (PSOs) for M.Sc. Organic Chemistry program:

After successful completion of two-year master's degree program in Organic Chemistry, should be able to;

PSO No.	PSO	Cognitive level
PSO1	Demonstrate an understanding of the basic concepts, fundamental principles, and the scientific theories related to Organic Chemistry and their relevancies in the day-to-day life, industry, and health.	**2**
PSO2	Gain proficiency and skills in laboratory techniques of Chemistry with	**3**

	handling scientific instruments, planning and performing in laboratory experiments.	
PSO3	Develop various skills such as communication, managerial, leadership, entrepreneurship, teamwork, social, research etc., which will help in expressing ideas and views clearly and effectively.	**3**
PSO4	Analyze the given scientific experimental data (reactants, products, reagents, catalyst, solvent, temperature, yield, purity, spectral data etc.) critically and systematically and the ability to draw the objective conclusions.	**4**
PSO5	Learn to work as a team as well as independently to retrieve information, carry out research investigations and result interpretations.	**5**
PSO6	Develop the ability to understand and practice the ethics of surrounding scientific research.	**5**
PSO7	Design, synthesis, characterization, and applications of organic compounds.	**6**

	CH-350: Organic Reaction Mechanism **(60 L, 100 Marks and 4 Credits)**	
	Course Objectives: To make the students conversant with the CO-1. Learn in detailed strength of acid and bases. Understand the Linear free energy relationship, Hammett and Taft equation, substituent and reaction constants. CO-2. Study of detailed mechanism of hydrolysis with breaking and formation of sigma bond. CO-3 Study of reaction of carbanion with detailed mechanism, coupling reactions along with name reactions. CO-4 Study of basics of photochemical reactions and learn various photochemical reactions. CO-5. Study of free radicals: generation of radicals, Nucleophilic electrophilic radicals, inter and intra molecular C-C bond formation, reactions of free radicals. CO-6. All the major types of organic reaction mechanisms.	
	Course Contents (Topics and subtopics)	
1	**Physical Organic Chemistry:** **Strength of Acids and Bases: Factors affecting acidity and basicity:** Comparative study of acidity and basicity of organic compounds on the basis of pKa values, Leveling effect and non-aqueous solvents. Acid and base catalysis – general and specific catalysis with examples. Aromaticity and solvation. **Linear free energy relationship:** Hammett plot, Hammett equation, substituent and reaction constants, physical significance of substituent constant and reaction constants, substituent constant involving through conjugation. Use of Hammett plot and equation. Deviations from straight line plot. Concave upward deviation. Concave downward deviation. Steric effects, Taft equation, Steric parameters, solvent effects, change of reaction constant. **Ref. 1, 2, 3**	**14 L**
2	**Ester hydrolysis and decarboxylation:** Classification, nomenclature and study of all eight mechanisms of acid and base catalyzed hydrolysis with suitable examples. Decarboxylation reaction. **Ref.1, 4, 5, 6**	**07 L**
3	**Reaction of carbon nucleophiles with carbonyl groups:** Carbanions: Generation of carbanion, kinetic and thermodynamic enolate formation, Regioselectivity in enolate formation, alkylation of enolates. Generation and alkylation of dianion, medium effects in the alkylation of enolates, oxygen versus carbon as the site of	**12 L**

	alkylation. Alkylation of aldehydes, ketones, esters, amides and nitriles. Chemistry of enolates and enamines, Kinetic and Thermodynamic enolates, Lithium and boron enolates in aldol and Michael reactions, Alkylation and acylation of enolates, Nucleophilic additions to carbonyls and stereochemical aspects through various models (Cram / Cram chelation / Felkin-Anh models); Organolithium, Organomagnesium, Organozinc, Organocopper reagents (restricted to 1,4-addition) in synthesis, Recall of Name reactions, their Mechanism and regiochemistry in the reactions under carbanion chemistry - Claisen, Dieckmann, Knoevenegal, Stobbe, Darzen, Acyloin & Benzoin condensations, Shapiro reaction, etc **Ref. 2,7, 8, 9, 10, 11**	
4	**Reactive intermediate: Carbene and Nitrenes** Method of generation, structure, stability and reactions involving carbene and nitrenes **Ref. 2,7, 12, 13**	**05 L**
5	**Photochemistry** Introduction to Basic Principles of Photochemistry. Nature of transition (n-π*, π-π*, d-d transition and Charge transfer), Norrish type-I and Norrish type-II reaction, abstraction of γ-hydrogen in cyclic and acyclic compounds, formation of bicyclic and tricyclic compounds, Paterno-Buchi reaction (including reaction of enones, ynones and quinones), allenes, Photoreduction (toluene and 2-propanol) Photochemistry of alkene Intermolecular and intramolecular reactions, geometrical isomerization, Cyclization reactions, addition, Paterno Buchi reaction, Di-pi methane rearrangement including aza-di-pi methane. Photochemistry of aromatic compounds Isomerization, additions and substitutions. **Ref. 12, 14**	**14 L**
6	**Free Radical Reactions:** Formation, stability and detection of long and short-lived radicals. Homolysis and free radical displacement, Fragmentation, substitution, addition, oxidation, reduction, and rearrangements, Radical cyclisation in synthesis. **Ref. 15**	**08 L**
	References: 1. A guide book to mechanism in Organic Chemistry 6th edition, By Peter Sykes: Orient Longman 2. Organic Chemistry, J. Claydens, N. Greeves, S. Warren and P. Wothers, Oxford University Press 3. March‘s Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 4. Jerry March "Advanced Organic Chemistry, Reactions, Mechanism And Structure " Fourth Edition Page No.374-396 5. Morrison And Boyd, Sixth Edition Page No.753-754	

6. P.S.Kalsi Fourth Edition Pages No.269-275
7. Advanced Organic Chemistry Part A and B 2ndedition, by F. A. Carey and R. J. Sundberg. Plenum Press. New York and London.
8. Morrison R.T Boyd & Bhattacharjee S.K,"ORGANIC CHEMISTRY" Seventh Edition 1992 Page No.69-72
9. S.M.Mukherji, S.P. Singh Reaction Mechanism In Organic Chemistry
10. Smith M.B & March J ," MARCH'S ADVANCED ORGANIC CHEMISTRY ", Sixth Edition, John Wiley & Son's, New Delhi 2007,Page No.249-265
11. Arun Bahl And B.S Bahl Advanced Organic Chemistry
12. Advance Organic Chemistry: Reactions, Mechanisms and Structure by Jerry March.
13. Modern method of organic synthesis by W. Carruther (Cambridge)
14. Organic Chemistry 5thedition, By S. H. Pine. MaGraw-Hill International editions. Page no. 1023-1041.
15. Organic Chemistry 5thedition, By S. H. Pine. MaGraw-Hill International editions. Page no. 911-938
16. Mechanism and structure in Organic Chemistry, Edwin S. Gould, Holt, Rinechart and Winston.
17. Advanced Organic Chemistry 3rdedition, by R. O. C. Norman and J. M. Coxon 3rd edition ELBS.
18. S.M.Mukherji, S.P. Singh Reaction Mechanism In Organic Chemistry
19. Photochemistry and Pericyclic Reactions 3rd edition, by Jgdambasingh, Jaya Singh

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	Understand basic concepts of strength of acids and bases, factors affecting the strength of acid and bases	**2**
2	Acquire the skills to identify the pathway of reaction.	**3**
3	Formulate his/her own reasoned opinions in the mechanistic side of organic reactions.	**3**
4	Predict the major and minor products of a variety of organic reactions with appropriate stereochemistry.	**3**

	CH-351: Spectroscopic Methods in Structure Determination (60 L, 100 Marks and 4 Credits)	
	Course Objectives: To make the students conversant with the CO-1. Study ^{1}H NMR Spectroscopy: Chemical Shift, deshielding, correlation for protons bonded to carbon and other nuclei. CO-2. Study of ^{13}C NMR spectroscopy: FT- NMR, type of ^{13}C NMR spectra, proton decoupled, off resonance, DEPT, DANTE, Chemical shift, nuclear and hetero nuclear coupling constant CO-3. 2D NMR techniques: COSY, homo and hetero nuclear 2D resorts spectroscopy, NOESY and the applications. CO-4. Study of mass spectrometry: Instrumentation, various methods of ionization, FAB, ESI, TPSI, MALDI, TOF, Mass spectral fragmentation of Organic compounds	
	Course Contents (Topics and subtopics)	
1	**A. Recapitulation of UV-Visible and IR Spectrometry:** spectroscopy, UV & Visible Spectrophotometry (General discussion about non conjugated, conjugated double bond absorption and λ max), IR Spectrophotometry (General discussion about instrumentation and frequencies of different functional group), Determine empirical formula from percent composition of a compound, The rule of Thirteen. **Ref. 1, 2, 3** **B. Proton Magnetic Resonance (H^{1} NMR):** Recapitulation, advanced ideas of chemical shift, chemical exchange, effect of deuteration, spin-spin coupling, (n+1) rule, identification of complex spin-spin interaction between two, three, four and five nuclei (first and second order spectra), stereochemistry, hindered rotation, identification of complex spin system AB, ABC, ABX and AMX systems. Factors affecting vicinal and germinal coupling, long range coupling. Simplification of complex spectra, nuclear double resonance, nuclear overhauser effect, shift reagents, solvent effect on chemical shift value. **Ref. 1, 2, 3,**	**(04 L)** **(10 L)**
2	**Carbon Magnetic Resonance (C^{13} NMR):** Elementary means, chemical shift, chemical shift features of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbon, factors affecting chemical shifts, Homo nuclear (^{13}C-^{13}C) and Hetero nuclear (^{13}C-^{1}H) coupling constants, Structural applications of CMR, DEPT, DANTE, un-decoupled, Proton decoupled, Off resonance. **Ref. 1, 2, 6**	**12 L**
3	**Two-Dimensional NMR Correlation Spectroscopy:** Two-dimensional NMR spectroscopy, ^{1}H-^{1}H COSY, ^{1}H-^{13}C HETCOR **Ref. 1, 4**	**04 L**
4	**NMR Spectroscopy of Some Other Nuclei -** ^{15}N, ^{19}F, ^{31}P and D and ^{11}B. **Ref. 1, 4, 5,**	**04 L**
5	**Mass Spectrometry:** Theory, Instrumentation, EI, Chemical Ionization, Field Desorption, FAB, ESI, MALDI, TPSI, TOF, MALDI-TOF, Mass Spectral fragmentation of Organic compounds containing common functional groups, McLafferty rearrangement, Molecular Ion peak, metastable peak, isotope peaks, Examples of Mass spectral fragmentation of Organic compounds with	**14 L**

	respect of their structure determination. **Ref. 1, 8**	
6	**Problems:** Based on joint application of UV, IR, PMR, CMR and Mass spectroscopy (including reaction sequence and spectral analysis). **Ref. 1, 6,7**	**12 L**
	References: 1. Introduction to Spectroscopy – D. L. Pavia, G.M. Lampman, G. S. Kriz, 3rd Ed. (Harcourt college publishers). 2. Spectrometric identification of organic compounds R. M. Silverstein, F. X. Webster, 6th Ed. John Wiley and Sons. 3. Spectroscopic methods in organic chemistry - D. H. Williams and I. Flemming Mc Graw Hill 4. Organic structures from spectra –Field L.D., Kalman J.R. and Sternhell S. 4th Ed. John Wiley and sons Ltd. 5. Organic spectroscopy-William Kemp, E L B with McMillan 6. Spectroscopy of organic molecule-PS Kalsi, Wiley, Esterna, New Delhi 7. Interpretation of NMR spectra-Roy H Bible 8. Mass spectrometry organic chemical applications, J H Banyon	
	Course Out comes:	
	The students will be able to - Interpret the spectral graphs. - Determine molecular structure by using UV, IR, NMR and Mass. - Learn the structure determination of organic molecules by spectroscopic methods and by using the applications of IR spectroscopy for functional group determination. - Determine the complete structure of compounds using UV, IR, PMR, CMR and Mass spectroscopic methods.	

CH-352: Organic Stereochemistry (60 L, 100 Marks and 4 Credits)		
	Course Objectives: To make the students conversant with the CO-1. To learn and apply various concepts such as stereochemistry and fundamental principles of stereoselectivity in organic chemistry. CO-2. Study of different types of pericyclic reactions. CO-3. Study of stereochemical aspects of fused and bridged rings. CO-4. Study of stereochemical aspects of six membered and other related rings CO-5 Study of prochirality and topocity.	
	Course Contents (Topics and subtopics)	
1	**Concept of Stereochemistry:** Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction. Prochirality and Topocity. **Ref. 1 (Pages: 465-488), 2, 3, 4 Pages: 187-206**	**10 L**
2	**Asymmetric Synthesis:** Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst-controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Racemic modification and resolution of racemic mixture (optical and kinetic). **Ref. 1, 5 (Pages: 1107-1125), 6**	**10 L**
3	**Stereochemistry of six membered rings & their reactions:** Different shapes of cyclohexane and substituted cyclohexane ring, reactions associated with cyclohexyl skeleton. Mono, disubstituted cyclohexane-physical properties (optical activity/energetics), Stereochemistry of ring other than six membered rings. Trans annular effect, concept of I-strain. Conformational effects in larger rings, Anti butane segment. **Ref 1, 2, 4, 5, 6, 7, 9, 10 & 11**	**10 L**
4	**Fused Rings and Bridged Rings:** Decaline, Perhydro phenanthrene, Perhydro anthracene, Bridged Compounds and Other related compounds **Ref. 1 (Pages 771-793) 2 (Pages 306-310; 318-323; 327-333)**	**10 L**
5	**Pericyclic Reactions:** 5.1 Introduction, Classification, Molecular orbital symmetry properties, three approaches: Co-relation diagram, FMO & PMO or ATS approach.	**20 L**

	5.2 Electrocyclic reactions: Con rotatory & Dis rotatory motions, 4n and 4n+2 & allyl system. 5.3 Cycloaddition reaction: Antarafacial & Suprafacial additions, 4n, 4n+2 systems, Diels-Alder reaction and its stereochemistry, 2+2 addition of ketones, secondary orbital interaction in cycloaddition reaction, 1,3-dipolar cycloaddition and chelotropic reactions. 5.4 Sigmatropic rearrangement: Suprafacial & Antarafacial shifts of H and carbon moities, Claisen, Cope &aza cope, Ene reactions and Fluxional molecule. **Ref. 7, 8, 9**	
	References: 1. Stereochemistry of organic compounds. E L.Eliel and S. H. Wilen 2. Stereochemistry. Nasipuri(Second Ed.). 3. Organic Chemistry- by Finar 4. Stereochemistry- Confirmation and Mechanism (8th edition)-P. S. Kalsi 5. Organic Chemistry-Clayden, Greeves, Warren and Wothers-OXFORD (Second Ed.) 6. Stereoselective synthesis—Mihaly Nograd VCH, Weinheim,1995. 7. Frontial orbitals and Organic Chemical Reactions. I N Flaming. 8. Orbital Symmetry: Problem Solving Approach. R. E. Lehr and Merchand. 9. Photochemistry and Pericyclic reactions- Jagadamba singh 10. Stereochemistry, D. G. Morris, RSC Tutorial Chemistry Text 1, 2001 11. Basic stereochemistry of organic molecules -Subrata Sen Gupta(Oxford)	
	Course Outcomes:	
	The students will be able to Differentiate stereoisomers. Understood stereochemical aspects of organic reactions. Understood the concept of asymmetric synthesis and resolution. Understood different types of pericyclic reactions. Understood stereochemical equivalence and nonequivalence.	

	CH-353 A: Heterocyclic Chemistry (60 L, 100 Marks and 4 Credits)	
	Course Objectives: To make the students conversant with the CO-1. Study of heterocyclic chemistry: Five and six members heterocyclic with one or two hetero atoms. CO-2. Study of condensed five- and six-member heterocyclic compounds. CO-3. Study the synthesis, reactivity, aromatic character and important reactions of heterocyclic compounds. CO-4 Students knows the importance of heterocycles in industry as well as drug discovery. CO-5 Create research oriented intrest among the students.	
	Course Contents (Topics and subtopics)	
1	Introduction, Synthetic Approaches & Reactions of following Heterocyclic Compounds **A)** Nomenclature of Heterocyclic system **B)** Three Membered and Four Membered Rings containing One Hetero Atom: Aziridine, Oxirane, Thiirane and Azetidine, Oxetane, Thietane **Ref. 1 (Pages: 1-41, 76-95), 2, 3**	**08 L**
2	**Five Membered Heterocyclic Compounds with One Hetero Atom:** Pyrrole, Furan, Thiophene **Ref. 1(Pages: 102-138), 2, 3**	**10 L**
3	**Five Membered Heterocyclic Compounds with Two Hetero Atoms:** Imidazole, Oxazole, Thiazole **Ref. 1 (Pages 183-214), 2, 3**	**06 L**
4	**Condensed Five-Membered Heterocycles:** Indole, Benzofuran, Benzothiophene **Ref. 1 (Pages 150-175), 2, 3**	**10 L**
5	**Six Membered Heterocyclic Compounds with One Hetero Atom:** Pyridine, Quinoline, Isoquinoline **Ref.1 (Pages: 222-261, 273-300), 2, 3**	**12 L**
6	**Six Membered Heterocyclic Compounds with Two Hetero Atoms and Heterocycles Containing a Ring-Junction Nitrogen:** Pyridazine, Pyrimidine, Pyrazine, Indazoline **Ref. 1 (pages 308-330), 2, 3**	**08 L**
7	**A) Heterocycles in Industry and Technology:** Heterocycles and Natural Colors, Dyes, Fluorescent Agents: Why They Shine, Safety and Aesthetics, Markers and Tracers, Imaging and Diagnostic Agents, Heterocycles as Food	**06 L**

	Additives. **B) Heterocyclic compounds in Drug Discovery:** Introduction, Importance of Heterocycles in Life, Importance of Heterocycles in Drug Discovery: Five-Membered Heterocycles with One Heteroatom (Atorvastatin and Imitrex), Five-Membered Heterocycles with Two Heteroatoms (Cemitidine and Celecoxib), Six-Membered Heterocycles with One Heteroatom (Omeprazole), Six-Membered Heterocycles with Two Heteroatoms (Gefitinib and Eszopiclone). **Ref 4: (Pages: 209-213, 218-225, 237-238), 5 (Pages: 5-16)**	

References:

1. Principles of Modern Heterocyclic Chemistry by Leo A. Paquette New York: Benjamin.
2. Heterocyclic Chemistry: 5th Edition by John A. Joule, Keith Mills, A John Wiley & Sons, Ltd., Publication.
3. Heterocyclic Chemistry: 5th edition by Raj K. Bansal, New Age International (P) Ltd.
4. Heterocycles in Life and Society: An Introduction to Heterocyclic Chemistry, Biochemistry and Applications, Second Edition. Alexander F. Pozharskii, Anatoly T. Soldatenkov and Alan R. Katritzky. 2011 John Wiley & Sons, Ltd. Published 2011 by John Wiley & Sons, Ltd. ISBN: 978-0-470-71411-9
5. Heterocyclic chemistry in drug discovery edited by Jie Jack Li. Copyright 2013 by John Wiley & Sons, Inc. All rights reserved. Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

Course Outcomes:

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

- Understood various methods of synthesis of heterocyclic compounds.
- Acquire skill to predict reactivity of heterocyclic compounds.
- To predict the product and suggest the mechanism.
- Understand the importance of heterocycles in industry as well as in drug discovery.

	CH-353 B: Green Chemistry (60 L, 100 Marks and 4 Credits)	
	Course Objectives: To make the students conversant with the CO-1. To study the importance of green and sustainable development in Chemistry, CO-2. To study a state-of-the-art strategy to design green and sustainable protocol for organic transformations, CO-3. To be familiar with the current progress in green synthesis, CO-4. To understand the role of catalysts, solvents in organic transformations, CO-5. To understand different energy sources for greener development, and CO-6. To explore the principles of green chemistry towards biomass treatment.	
	Course Contents (Topics and subtopics)	
1	**Brief Introduction of Green Chemistry.** What is Green and Sustainable development in Chemistry? Need for Green and Sustainable Chemistry. Goals of Green Chemistry. Boundaries/Hurdles to achieve the goals of Green Chemistry. **Ref.1, 2, 3, 4**	**06 L**
2	**Designing a Chemical synthesis in accordance with the Principles of Green Chemistry.** Twelve principles of Green Chemistry with their brief explanations and examples, Selection and Designing of a process using these principles such as Waste/byproducts minimization, Atom Economy, Control the formation of hazardous/toxic products, designing safer and cost-efficient chemicals for the synthesis, selection of appropriate solvents, separation agents and other auxiliary substances, green solvents, processes without solvent, immobilized solvents, supercritical fluids and ionic liquids, energy requirements for the synthesis (use of microwaves, ultrasonic energy),proper selection of starting materials (avoiding unnecessary derivatization as well as blocking/protecting groups),catalyst and use of catalytic reagents (wherever possible) in preference to stoichiometric reagents, optimizing reaction conditions in such a way that they leads the formation of biodegradable products, avoids chemical accidents and associated with the development of analytical techniques to prevent or minimize the formation of hazardous substances in chemical processes. **Ref. 4,5 , 6, 7, 8, 9, 10, 11, 12**	**24 L**
3	**Examples of Green Synthesis/Reactions.** 1. Green Synthesis of the following compounds: styrene, adipic acid, catechol, 3-dehydroshikimic acid, methyl methacrylate, 4-aminodiphenylamine, Free radical bromination, (S)-metolachlor, citral, nicotinic acid, ibuprofen, paracetamol, furfural.	**24 L**

	2. Microwave assisted reactions in water as reaction medium: Hofmann Elimination, Hydrolysis of important organic functions including benzyl chloride, benzamide, n-phenyl benzamide, methyl benzoate, Oxidation of alcohols. Microwave assisted reactions in organic solvents as a reaction medium: Esterification and Trans esterification, Fries rearrangement, Diels-Alder Reaction. Microwave assisted solid state transformations: Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of azoles (pyrimidine and pyridine). 3. Ultrasound assisted reactions: Esterification, oxidation, reduction, coupling (diazocoupling) and cross-coupling reactions (Stille, Suzuki, and Heck), Strecker synthesis, and Reformatsky reaction, Simmons-Smith Reaction. 4.Use of dimethyl carbonate in organic transformations, use of heterogeneous catalysis, zeolites, silica, alumina, supported catalysis- bio catalysis. **Ref. 9, 13, 14, 15**	
4	**Future Trends in Green Chemistry.** Green chemistry in Agriculture; enhancement of ethanol yield from the corn dry grind Process by conversion of the Kernel Fiber fraction. Green Chemistry in polymer synthesis; Designing and applications of bio-composites. Exploring green chemistry towards biomass treatment. **Ref. 16 (PP 12-26, 63-77), 17 (pp 317-352), 18 (1-10)**	06L
	References: 1. P. T. Anastas, I. J. Levy and K. E. Parent. Green Chemistry Education Changing the course of chemistry. ACS Symposium Series 1011 (2009). 2. P. T. Anastas and T. C. Williamson. Green Chemistry Designing chemistry for the environment. ACS Symposium Series 626 (1996). 3. R. L. Lankey and P. T. Anastas. Advancing sustainability through green chemistry and engineering. ACS Symposium Series 823 (2002). 4. A. S. Matlack. Introduction to Green Chemistry. Marcel Deckkar (2001). 5. M. Lancaster. Green chemistry; An introductory text. Royal Society of Chemistry (2002). 6. P. T. Anastas and J. B. Zimmerman. Innovations in Green Chemistry and Green Engineering Selected Entries from the Encyclopedia of Sustainability Science and Technology. Springer (2013). 7. C. A. M. Afonso and J. G. Crespo. Green Separation Processes. Willey-VCH (2005). 8. P. T. Anastas and C. A. Farris.Benign by Design Alternative Synthetic Design for Pollution Prevention. ACS Symposium Series 577 (1994). 9. V.K. Ahluwalia and M.R. Kidwai. New Trends in Green Chemistry. Anamalaya Publishers (2005). 10. P. T. Anastas. L. G. Heine. Green Chemical Syntheses and Processes. ACS Symposium Series 767 (2002). 11. D. J. Constable and C. Jimenez-Gonzalez. Handbook of Green Chemistry. Volume11: GreenMetrics. Willey-VCH (2018). 12. M. Doble and A. K. Kruthiventi. Green Chemistry and Engineering. Elsevier (2007). 13. P. Tundo, A. Perosa and F. Zecchini. Methods and reagents for green chemistry; An introduction. John Willey and Sons (2007).	

14. R. A. Sheldon, I. Arends and U.Hanefeld. Green Chemistry and Catalysis. Willey-VCH (2007).
15. M. C. Cann. Green Organic Chemistry in Lecture and Laboratory. CRC Press, Taylor and Fransis Group (2012).
16. W. M. Nelson. Agricultural Applications in Green Chemistry. ACS Symposium Series 887 (2004).
17. S. C. Ameta and R. Ameta. Green Chemistry; Fundamentals and Applications. CRC Press (2013).
18. S. Vaz Jr. Biomass and Green Chemistry; Building a Renewable Pathway. Springer (2018).

Course Outcomes (COts):

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

CO No.	CO	Cognitive level
1	Familiar with the Principles of green chemistry in detail	**2**
2	Learn how to develop a green and sustainable protocol for organic synthesis	**3**
3	Explore green and sustainable practices beyond organic synthesis	**3**

CH-450: Chemistry of Natural Products (60 L, 100 Marks and 4 Credits)		
	Course Objectives: To make the students conversant with the CO-1. To study the important features of terpenoids. CO-2. To study secondary metabolism of Amino acids. CO-3. To study the biosynthesis of natural products. CO-4. To apply the knowledge of different reagents for synthesis of natural product. CO-5. To understand the classification and uses of vitamins.	
	Course Contents (Topics and subtopics)	
1	**Structure, Stereochemistry and biogenesis of** 1) Hardwickiic acid 2) Podophyllotoxin **Ref.1, 2**	**12 L**
2	**Multistep Synthesis of Some Natural Products** i) Reserpine (R.B.Woodward Synthesis) ii) Taxol (K.C. Nicolaou Synthesis) iii) Estrone (K.P.C.Vollhardt Synthesis) iv) Strychnine (L.E.Overman Synthesis) v) Prostaglandin (E.J.Corey Synthesis) **Ref.3. (Pages 55-63, 65-81,153-165,641-652,655-671), .4**	**12 L**
3	**Secondary Metabolism:** Primary and secondary metabolism, Enzyme and Coenzyme, The Building Blocks. 1. Metabolites Derived from Mevalonates: Terpenoids – Mono, Sesqui, Di and Triterpenoids and Cholesterol. 2. Metabolites Derived from Shikimic acid: cinnamic acids, lignans and lignin, coumarins, flavonoids and terpenoid quinones. 3. Secondary metabolism of Amino acids: Alkaloids derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan. **Ref. 5 (6-17,95-142,173-189,192-243), Ref.6.(7-30, 121-158, 167-226, 291-368), 7, 8, 9**	**28 L**
4	**Vitamins** **a)** Classification, sources and biological importance of vitamin B1, B2, B6, folic acid, B12, C, D1, E (α-tocopherol), K1, K2, H (β- biotin). **b)synthesis of the following:** Vitamin B1(including synthesis of pyrimidine and thiazole moieties	08 L

	Vitamin B2 from 3, 4-dimethylaniline and D (-) ribose Vitamin B6 from: Ethoxyacetylacetone and cyanoacetamide Vitamin E (α-tocopherol) from trimethylquinol and phytyl bromide Vitamin K1(α- Phylloquinone) from 2-methyl-1, 4-naphthaquinone and phytol. Vitamin Folic acid from Guanidine and ethyl cyano acetate. **Ref.10. (598-603,604-607, 615-617, 619-621, 623-625), Ref. 11 (116-156), 12, 13**	
	References: 1.i) Tetrahedron Letter No.49, pp. 3751-3759, 1964. Pergamon Press Ltd. Printed in Great Britain. ii) Tetrahedron vol.35 Pages 2301-2310 Pergamon Press Ltd. Printed in Great Britain. 2. i) J.C.S. Perkin Transactions II, 288-292, (1973). ii) J. Am. Chem. Soc.Vol.77.432-437,(1955). 3. Classics in Total Synthesis: By Nicolaou, K. C. and Sorensen, E. J. (1996) Targets, Strategies, Methods, Wiley VCH. 4. Principles of Organic Synthesis By-Norman, R. O. C. and Coxon, J. M. (1993). by Chapman and Hall, 3rd Edition, CRC Press. 5.Secondary Metabolism, J. Mann, 2nd Edition (Oxford UniversityPress). 6. Medicinal Natural Products: A Biosynthetic Approach, By Paul M Dewick.A John Wiley and Sons, Ltd, Publication. 7. Chemical aspects of Biosynthesis – J. Mann (1994). 8. Biogenesis of Natural Products. By- Baldev Kumar, Harish Kumar Chopra. Narosa Publishing House Pvt.Ltd. 9.Biosynthesis of Natural Products. P.Manitto. 10. Organic Chemistry, Vol. II Stereochemistry and Chemistry of Natural Products By.I.L.Finar. 11. Biochemistry, Dr U Satyanarayan and Dr U Chakrapani, Books and Allied (P) Ltd. 12.Outline of Biochemistry By- E.E.Conn and P.K.Stumpf.4th edition John Wiley and Sons, New York and London 13.Principles of Biochemistry by Lehninger, Macmillan Education	
	Course Outcomes:	
	Students will be able to • Learn the chemistry of terpenoids. • Learn the chemistry of Alkaloids derived from Amino acids. • Learn the structure, biogenesis of some natural products. • Utilized the knowledge of reagents in multi-step synthesis of biologically active members. • Explain the classification of vitamins and their biological importance.	

	CH-451: Synthetic Methods in Organic Chemistry **(60 L, 100 Marks and 4 Credits)**	
	Course Objectives: To make the students conversant with the CO-1. Study of transition metal complexes in organic synthesis. CO-2. Study of different types of coupling reactions. CO-3. Study of Umpolung and Protecting Groups. CO-4. To learn and apply various concepts retrosynthesis. CO-5. Some Advanced Synthetic Reactions.	
	Course Contents (Topics and sub-topics)	
1	**Applications following elements in organic synthesis** a)Boron b) Thallium **Ref.:** 1. Organic synthesis, The role of Boron and Silicon, Susan E. Thomas, Oxford University Press. 2. Modern methods of organic synthesis – W. Carruthers (Cambridge) pp, 315-330 3. Organic Synthesis, Jagdamba Singh and L.D.S. Yadav, A Pragati Edition, pp 354-357	**05 L**
2	**Uses of transition metal complexes in organic synthesis** i. Ni (Uses of Nickel carbonyl, Ni $(COD)_2$) ii. Pd (Heck, Suzuki, Stille, Sonogashira, Negishi, Buchwald-Hartwig Couplings, Wacker process) iii. Pt (Hydrogenation) iv. Ru (Grubb's Catalyst, only Ring closing & Ring Opening metathesis, polymerization) v. Co (Oxo process, Pauson Khand Reaction, Vollhardt co-trimerization) vi. Fe (Tetracarbonyl ferrate, Noyori reaction **Ref:** 1. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press) 2. Modern methods of organic synthesis – W. Carruthers (Cambridge) pp 75-105, 405-421. 3. Organometallics in organic synthesis – J. M. Swan and D. C. Black (Chapman & Hall) 4. Organic Synthesis, Jagdamba Singh and L.D.S. Yadav, A Pragati Edition 5. Modern Organic Synthesis an Introduction –G.S. Zweifel and M. H. Nantz, Second edition, Wiley Publication	**14 L**
3	**Umpolung in Organic Synthesis** **Ref:** 1. Some modern methods of organic synthesis – W. Carruthers (Cambridge), pp 1-45 2. Organic chemistry – J. Clayden, N. Greeves, S. Warren, Second edition (Oxford Press) 3. Organic Reaction Mechanisms- V.K. Ahluwalia & Rakesh K. Parashar (Fourth Edition), Narosa Publication pp, 128-134	**04 L**
4	**Nitrogen, Phosphorous and Sulphur Ylides in Organic synthesis** **Ref:** 1. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers(Oxford Press) 2. Some modern methods of organic synthesis – W. Carruthers (Cambridge) 3. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007)	**05 L**

5	**Protecting groups in Organic Synthesis:** Protection & deprotection of Hydroxyl, Carbonyl, amino and carboxylic acid functional groups & its applications, solid phase peptide synthesis. **Ref:** 1. Organic chemistry – J. Clayden, N. Greeves, S. Warren (Oxford Press) 2. Modern Organic Synthesis an Introduction –G.S. Zweifel and M. H. Nantz, Second edition, Wiley Publication 3. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007) 4. Protective groups in organic synthesis, T. W. Greene and P. G. M. Wuts, 2^{n}d Ed. John Wiley and Sons, 1991.	**06 L**
6	**Designing in Organic Synthesis:** Disconnection Approach: An introduction to synthons and synthetic equivalents, functional group interconversions. **One group Disconnections: Disconnections** of simple alcohols, simple olefins, Aryl ketones, control, Disconnections of simple ketones & acids, two group Disconnections: 1,3-Dioxygenated skeletons, -β-hydroxy carbonyl compounds, α-β unsaturated carbonyl compounds,1,3 dicarbonyl compounds,1,5 dicarbonyl compounds –Use of Mannich reaction **Two group Disconnections:** The 1,2 Dioxygenation pattern –α -hydroxy carbonyl compounds,1,2 diols, Illogical electrophiles ,1,4 Dioxygenation pattern - 1,4 dicarbonyl compounds, γ hydroxy carbonyl compounds, other illogical synthons ,1,6 dicarbonyl compounds, pericyclic reactions, Heteroatoms & heterocyclic compounds **Linear and Convergent Synthesis** **Ref.** 1. Designing of organic synthesis – S. Warren (Wiley) pp 4-318 **2.** Organic chemistry – J. Clayden, N. Greeves, S. Warren, (Oxford Press)	**16L**
7	**Some Advanced Synthetic Reactions** a) **Click chemistry:** Introduction, Criteria for Click reaction. Sharpless azides cycloadditions b) **Olefination reactions:** Tebbe, McMurry, Julia-Lythgoe, Peterson‘s Olefination c) **Fragmentaion reactions:** Eschenmoser, Grob. d) **Some other reactions:** Mitsunobu, Nef, Staudinger, Brook rearangment. **Ref:** 1. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press) 2. Some modern methods of organic synthesis – W. Carruthers (Cambridge) 3. www.organicchemistryportal.com 4. www.synarchive.com	**10 L**
	Course Outcomes: The students will be able to • Understand and apply the specific protecting groups for the reactant to react the desirable functional group. • Design the synthetic pathway from target molecule by applying the retrosynthesis, disconnection approach. • Understand various synthetic methods in organic synthesis. • Understand advanced organic reactions.	

CH-452(A): Drug Chemistry (60 L, 100 Marks and 4 Credits)		
	Course Objectives: To make the students conversant with the CO-1. To learn structure features of various drug molecules. CO-2. Study of symptoms, treatment of different diseases. CO-3. Study of synthesis of various drugs molecules.	
	Course Contents (Topics and subtopics)	
1	**Introduction to medicinal chemistry** Classification, Nomenclature, Sources, Concepts of prodrugs and soft drugs, Receptor, Therapeutic index, Bioavailability, Drug assay and drug potency, Concept and definition of pharmacophore. Basic Pharmacokinetics: drug absorption, distribution, metabolism (biotransformation) and elimination, Pharmacokinetics- Drug targets: enzymes and receptors. Competitive, non-competitive inhibitors, Physical and chemical parameters like solubility, lipophilicity, ionization, pH, redox potential, H-bonding, partition coefficient and isomerism in drug distribution and drug-receptor binding, Factors affecting Absorption, Distribution, Metabolism, Elimination and Toxicity, Structure activity relationship.	**10 L**
2	**Antibiotics:** Introduction, Classification, Structure & Uses of Streptomycin, Penicillin,	**04 L**
3	**Antidiabetics:** Introduction, Classification, Management of Diabetes Mellitus, Insulin & Synthesis of Glibenclamide, Metformin	**06 L**
4	**Anticancer / Antineoplastic agents:** Introduction, Classification, Causes, Treatment of Cancer, Synthesis of Mechlorethamine, Melphalan.	**08 L**
5	**Anti-HIV Drugs:** Introduction, Classification, Causes, Prevention, Treatment, Synthesis of AZT	**06 L**
6	**Cardiovascular Drugs:** Introduction, Classification, Cardiovascular diseases, Synthesis of Amyl Nitrite, Sorbitrate, Atenolol. Antihypertension Drugs	**12 L**
07	**Psychoactive Drugs:** Introduction, Classification, Synthesis of Diazepam, Alprazolam	**05 L**
08	Introduction, Classification, Synthesis of some common drugs: Paracetamol, Cetrizine, Pentaprazole, Aceclophenac.. **Ref 1 Pages 199, Ref 2. Pages 4, 214,428,429,255-256, Ref 6 Pages 1017, 1019-1022**	**09 L**

	References: 1. Medicinal Chemistry. G. R.Chatwal. 2. Medicinal Chemistry—By A. Kar, Wiley,2000. 3. Strategies for Organic Drug synthesis and design—By D. Lednicer John Wiley1998. 4. Synthetic drugs—G. R. Chatwal—Himalaya, New Delhi1995. 5. Total synthesis of Natural product: The chiral approch Vol. III, S. Hanessian Pergamon Press1983. 6. Principles of Medicinal Chemistry (4thEdition) W. D. Foye, T. L. Lemke, D. A. Williams. 7. Organic Chemistry of Drug action and Design. R. B. Siwerman, (Academicpress, 1993). 8. Medicinal Chemistry - Alka L. Gupta. 9. Medicinal Chemistry - V. K. Ahluwalia & Madhu Chopra.	

Course Outcomes (COts):

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

CO No.	CO	Cognitive level
C102.1	Acquire knowledge on metabolism of biomolecules	**3**
C102.2	Familiarise with amino acids, proteins, lipids, nucleic acids and enzymes	**4**
C102.3	Understand biochemical reactions in microbial cells and metabolic pathway diversity	**2**

CH-452 :(B) Applied Organic Chemistry (60 L, 100 Marks and 4 Credits)		
	Course objectives 1. Study of important pesticides 2. Study of plant growth regulators and insect repellents 3. To learn about toxic effects of Chemicals. 4. Study of synthesis of important dyes intermediates 5. To learn mechanism of polymerization and study of different polymers	
	Course Contents (Topics and sub-topics)	
1	**Agrochemical:** a. Carbamate pesticides: Introduction, carbaryl, Baygon, Aldicarb, Ziram, Zineb b. Organophosphorus pesticides: Malathion, monocrotophos, dimethoate, phorate, mevinphos c. Natural and synthetic pyrethroids: Isolation and structures of natural allethrin, fenvalerate, cypermethrin, d. Plant growth regulators: General survey synthesis of simple compounds e. Insect repellents: General survey and synthesis	**15 L**
2	**Chemical Toxicology** Toxic chemicals in the environments, Impact of toxic chemicals on enzymes, Biochemical effects of arsenic, cadmium, lead, mercury, carbon monoxide, nitrogen oxides, sulphur oxides.	**15 L**
3	**Dyes and Intermediates:** Synthesis of important dye intermediates. Commercial processes for Azo dyes, reactive dyes, optical brighteners, thermal sensitive dyes, dispenses dyes.	**15 L**
4	**Polymers:** Mechanism of polymerization. Study of polyesters, polyamides, PVC, polystyrene, polyvinyl acetate and polyvinyl alcohol, polyethene, viscose rayon, synthesis of polyethylene, polypropylene. Synthetic rubbers: Styrene-butadiene, butyl polyisoprene, phenol formation formaldehyde resin. Plasticisers and anti-oxidants for polymers, Natural polymers: Starch and cellulose.	**15L**
	Reference Books 1. Allan: Colour Chemistry 2. K. Venkataraman: Chemistry of Synthetic Dyes Vol- 1 to 7 3. Abrahart: Dyes & their intermediates 4. N. N. Melikov: The Chemistry of Pesticides and formulations 5. K. H. Buchel: Chemistry of Pesticides 6. R. Cleymlin: Pesticides 7. F. W. Billmeyer: Text book of Polymer Science	

	8. H. R. Alcock and F. W. Lambe: Contemporary Polymer Chemistry 9. J. M. G. Cowie, Blackie: Physics & Chemistry of Polymers 10. P. H. Groggins: Unit Processes in Organic Synthesis 11. B. Biollot & P. V. Wells: Perfumary Technology 12. M. Ash & I. Ash: A formulary of Cosmetic Preparations 13. A.K. De, Environmental Chemistry, 6th Edition, New Age International Private Ltd.,New Delhi.	
	Course outcomes: Students will able to 1. Acquire knowledge of different agrochemicals. 2. Familiar with Chemical toxicology. 3. Familiar with dyes and intermediates. 4. Familiar with preparation of various polymers.	

CH-O-2: Organic Chemistry Practical Course-II
(180Hrs, 100 Marks and 6 Credits)

Course Objectives: To make the students familiar with the

CO-1. To learn techniques for separation of ternary mixture carried out on micro-scale.

CO-2. Understand the isolation and separation technique of natural products.

CO-3. Interpretation of actual instrumental spectral data (UV, FT-IR, ^{1}H-NMR, CMR and Mass spectra)

Ternary Mixture Separation (Minimum Ten)

Separation of mixtures containing three components. The mixtures should also involve separation of nitro phenols, amino acids, low boiling substances, water soluble substances. Amines, Phenols and acids used should also contain other elements and functional groups. The mixture separation should be carried out on micro-scale using ether. The purity of the separated compounds should be checked by TLC.

Isolation and separation of Natural products: (Any Four)

It should involve solvent extraction, chromatographic & distillation techniques.

1) Isolation of Hesperdin from orange peel
2) Isolation of Eugenol from cloves
3) Isolation of Caffeine from tea
4) Isolation of Nicotine from tobacco
5) Isolation of Piperine from blackpepper
6) Isolation of Lactose and casein from milk
7) Isolation of Cellobiose-octa-acetate from cotton
8) Isolation of Stigmasterol from soya bean oil
9) Isolation of β-carotene from carrot

Spectral interpretation of UV, IR, ^{1}H-NMR, CMR and Mass Spectra: (Minimum 10 Organic Compounds)

References:

1. Vogel's, Practical Organic Chemistry.
2. Practical Organic Chemistry, R. K. Bansal.
3. Natural Product Isolation, Satyajit D. Sarker, Zahid Latif, Alexander I. Gray, 2nd Ed. Springer.
4. Practical Organic Chemistry by Mann & Saunders.
5. Organic Structures from Spectra, 4th Edition, L. D. Field, S. Sternhell, J. R. Kalman, John Wiley & Sons, Ltd.

Course Outcomes (COts):

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

CO No.	CO	Cognitive level
CH-O-2.1	Separate the ternary mixture with proper technique and identification of the type of given compound.	**4**
CH-O-2.2	Isolate and separate the organic compounds from natural products	**3**
CH-O-2.3	Collect the data and solve the structure by given spectral data.	**3**

CH-O-3: Organic Chemistry Practical Course-III
(180 Hrs, 100 Marks and 6 Credits)

Course Objectives: To make the students conversant with the
CO-1. To learn techniques for preparation of compounds.
CO-2. To learn two stage, three stage, multicomponent synthesis.
CO-3. To learn total synthesis technique.

- **Drying of Organic Solvents:**

Dry various commonly used organic solvents with several different drying agents. Recommending to optimum drying agents/conditions that can be used to rapidly and reliably generate solvents with low residual water content by means of commonly available materials found in most synthesis laboratories
Solvents: THF, Toluene, Dichloromethane, Acetonitrile, Methanol, Ethanol etc.

- **Two Stage Preparations Monitored by TLC**(Minimum Six)

1) Benzaldehyde - Benzoic acid - Benzamide
2) Benzaldehyde - Benzylidene Acetophenone - 4,5-dihydro 1,3,5-triphenyl-1H-pyrazole
3) Acetophenone - Oxime - Acetanilide.
4) Acetophenone- Benzalacetophenone - Epoxide
5) Nitrobenzene - m- Dinitrobenzene - m- Nitroaniline.
6) Nitrobenzene - n- Phenyl hydroxylamine - P amino Phenol
7) Acetophenone - Acetophenone Phenylhydrazone - 2-Phenyl Indole
8) Chlorobenzene- 2,4- dinitrochloro benzene - 2,4- dinitrophenol.

- **Three stage Preparation Monitored by TLC (**Minimum Four**)**

Prep-1: Synthesis of P-NitroAniline from Aniline
Step 1: Aniline to Acetanilide (Acetylation)
Step 2: Acetanilide to P- Nitroacetanilide (Nitration)
Step 3: P- Nitroacetanilide to P-Nitroaniline (Hydrolysis)
Prep-2: Synthesis of Methyl Orange from Aniline
Step 1: Aniline to sulphanilic acid (sulphonation)
Step 2: sulphanilic acid to Diazonium chloride (diazotization)
Step 3: Diazonium chloride to methyl orange (coupling reaction)
Prep-3: Synthesis of p nitro benzoyl peroxide from P- nitro toluene
Step 1: P- Nitrotoluene to p Nitro benzoic acid (Oxidation)
Step 2: P-Nitro benzoic acid to P-Nitro benzoyl chloride (Substitution)
Step 3: P-Nitro benzoyl chloride to P-Nitro benzoyl peroxide (Oxidation)
Prep-4: Synthesis of p-Bromo Benzanilide from Benzophenone
Step 1: Benzophenone to benzophenone oxime (Addition)
Step 2: Benzophenone oxime to benzanilide (Beckmann's rearrangement)
Step 3: Benzanilide to p-bromobenzanilide (Bromination)
Prep-5:synthesis of Benzilic acid from Benzaldehyde
Step 1: Benzaldehyde (using thiamine HCl) to Benzoin (condensation)
Step 2: Benzoin to Benzil (oxidation)
Step 3: Benzil to Benzilic acid (rearrangement)
Prep-6: Synthesis of Benzylamine acid from phthalic anhydride

Step 1: Phthalic anhydride to phthalimide (Amide formation)
Step 2: Phthalimide to N-Benzylphthalimide (N-Alkylation)
Step 3: N-Benzylphthalimide to Benzylamine (Hoffman Degradation Reaction)

- **Four Stage Preparation Monitored by TLC (Any One)**

Prep-7: Synthesis of o-chlorobenzoic acid from phthalic acid
Step 1: Phthalic acid to phthalic anhydride (Dehydration)
Step 2: Phthalic anhydride to phthalimide (Amide formation)
Step 3: Phthalimide- Anthranilic acid (Hoffman's reaction)
Step 4: Anthranilic acid to o-chlorobenzoic acid (Diazotization followed by sandmayer's)
Prep-8: Synthesis of Paracetamol from Benzene
Step 1: Benzene to Nitrobenzene (Nitration)
Step 2:Nitrobenzene to N-phenyl hydroxylamine (reduction)
Step 3: N-phenyl hydroxylamine to p-aminophenol (Bamberger Rearrangement)
Step 4: p-amino phenol to p-hydroxy acetanilide/paracetamol (acetylation)
Prep-9: Synthesis of m-Chloro-Nitrobenzene from Nitrobenzene
Step 1: Nitrobenzene to m-dinitrobenzene (nitration)
Step 2: m-dinitrobenzene to m-nitroaniline (partial reduction)
Step 3: m-nitro aniline to m-nitro diazonium chloride (diazotization)
Step 4: m-nitro diazonium chloride to m-Chloro-nitrobenzene (sandmayers reaction)

- **Multicomponent Reactions involving Green Chemistry Principles** (Any Four)

Reactions involving 2,3,4 compounds should be carried out on the basis of Green Chemistry Principles. The synthesis should be carried out on a micro scale. The progress of reaction should be monitored by TLC.

1) Synthesis of 2-amino-4H-chromene scaffold using aromatic aldehyde under Solvent-free condition catalysed by sodium carbonate (Knoevenagel–Michael addition)

2) Synthesis of 1,4-dihydropyridines in aqueous ethanol in one-pot condensation and cyclization of various types of aliphatic and aromatic aldehydes with ethyl acetoacetate and ammonium hydroxide solution (Hantzsch synthesis)

3) Synthesis of dihydropyrimidinone: acid-catalyzed three component reaction between aromatic aldehyde, ethyl acetoacetate and urea/thiourea. (Biginelli reaction)

4) Synthesis of highly functionalized pyrazoles: An efficient one pot multicomponent reaction of phenyl hydrazine, malononitrile and aromatic aldehydes in water using molecular I_2 as catalyst

5) Synthesis of pyrano[2,3-c] pyrazole derivative, condensation of aromatic aldehydes, activated methylene reagent, ethyl acetoacetate, and hydrazine hydrate in water medium.

6) Synthesis of coumarin by Knoevenagel reaction using salicylaldehyde, and ethyl acetoacetate in presence of a base.

References:

1. Vogel's, Practical Organic Chemistry.
2. Practical Organic Chemistry, R. K. Bansal.
3. Systematic lab experiment in Organic Chemistry by Arun Sethi.
4. Comprehensive Practical Organic Chemistry: By V.K. Ahluwalia, R. Aggarwal, V.K. Ahluwalia
5. Monograph on Green Chemistry Laboratory Experiments.
6. A Manual of Practical Organic Chemistry Day Sitaramam&Govindachari
7. Organic Experiments L.F.Fieser.
8. Systematic Identification of Organic Compounds, P.L.Shriner, R.C.Fuson&D.Y.Curtin.
9. Advanced Organic Synthesis by R.S.Monson Academic Press

10.Springer Science+Business Media B.V., Mol Divers (2010) 14:473–477
DOI 10.1007/s11030-010-9246-5

11. Organic Process Research & Development 2002, 6, 817−818 Brindaban C. Ranu,*AlakanandaHajra, and Suvendu S. Dey

12. New J. Chem., 2014, 38, 302, MadhulikaSrivastava,a Pratibha Rai,a Jaya Singhb and Jagdamba Singh* DOI: 10.1039/c3nj01149f

13.Tetrahedron Letters, Somnath Ghosh ,ForidSaikh, Jhantu Das, Arun Kumar Pramanik, http://dx.doi.org/10.1016/j.tetlet.2012.10.079,

14.Scholars Research Library Der Pharma Chemica, 2011, 3 (5):81-86 (http://derpharmachemica.com/archive.html), Samy A. El-Assaly

15. J. Org. Chem. Vol. 75, No. 24, 2010, pubs.acs.org/joc

Course Outcomes (COts):

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

CO No.	CO	Cognitive level
CH-O-3	The students will be able to Understand the organic synthesis techniques.	**2**

CH-O-4: A Short Research Project

(180Hrs, 100 Marks and 6 Credits)

Course Objectives:

CO-1. To make students familiarize themselves with the techniques such as synthesis, isolation, purification and characterization/analysis etc.

CO-2. To introduce students on how to generate new ideas based on literature survey and their Execution.

CO-3. To foster the self-confidence amongst the students to think and execute ideas Independently.

The project is allotted during the third semester. The students will get an opportunity to become a part of ongoing research activities in the respective supervisor's laboratory. This should make them familiar with the literature survey and the fundamental understanding of how to devise research methodology.It is expected that the student should learn the synthesis, isolation, purification and characterization techniques whatever applicable for their projects. Students whose projects are dependent on the instruments are expected to know SOP and their working principles. Full flexibility is given to the student in identifying the project depending on the resources and infrastructure available in the host organization. It is recommended to work on multidisciplinary projects but not mandatory. In any case, not more than 2-3 students should involve in the same project.

The systematic approach towards the execution of the project should be as follows:

1. Selection of topic relevant to priority areas of chemistry and allied sciences
2. Literature survey and devising research methodology based on the gaps in the literature
3. Good laboratory practices: Safety, MSDS, disposal of chemical waste etc.
4. Execution of the project by designing and performing suitable experiments
5. Interpretation of results and drawing important conclusions
6. To prepare a PowerPoint presentation using modern ICT tools
7. Students should present their research work in Avishkar/Webinars/Conferences
8. Maintaining lab notebooks and writing monthly progress report
9. Writing a dissertation with following components in a given order: Title of the Project, Certificates, Acknowledgement, Abstract and Keywords, Contents, Introduction, Literature, Aim of the Project,Materials and Methods, Results and Discussion, Conclusions and Future Perspectives, Contributions, Bibliography and References. Total three bound copies of the dissertation should be prepared (library, guide and student: each one copy). Student should note that plagiarism is strictly prohibited. Beside writing dissertation, students should write a manuscript/patent if the results obtained are worthy of publication.

10. Presentation during the university examination
11. The complete tenure of research project should be of one year. It should start at the third semester and will be end by the semester fourth.
12. Student should submit two progress report within the span of the project.
13. Student should be encouraged for applied and contemporary research work.
14. Weakly two days should be allotted to research project in a regular time table.
15. Each research group should not have more than four students.
16. Each research group should have different research topic

It highly recommended that the students should apply for the Summer Research Fellowship Programmes initiated by Science Academies of India - IAS, INSA, NASI. Similarly, there exist several other summer internship opportunities in the national institutes, reputed universities and industries. Students should explore these possibilities immediately after the completion of the second semester (M. Sc., Part - 1) meaning that applications should be sent much earlier. The exposure gained during the summer internship should build enough confidence amongst students to identify the right research project and its execution.

Examination Assessment (100 Marks):

Internal Examination (Internal Assessment) - 40 marks:

Activity	Marks
Submission of progress reports signed by supervisor (at least 2reports, 05 marks per report)	10
Outline of research work: - literature collected, experiment planning and design	08
Experimental work performed	08
Subject/topic related one workshop/course/instrumentation training (online/offline),	10
Regular attendance maintained by Research Supervisor	04

External Examination (External Assessment) - 60 marks:

Activity	Marks
Selection of topic of project work	05
Literature review	05
Characterization of intermediates / products	10
Overall quality of dissertation	10
Power point presentation	15
Oral discussion	10
Conference / Industrial Visit /Avishkar Participation	05

Suggested readings: Reference Books/Reviews/Journal Papers as suggested by the supervisor.

Course Outcomes (COts):		
Upon the completion of course, the student should be able:		
CO No.	**CO**	**Cognitive level**
1	To generate new research ideas based on the comprehensive literature survey	**3**
2	To acquire skill to execute the research project independently	**2**
3	To expertise in synthesis techniques and execution of research ideas would make the student quickly employable; either in industries or in academia for pursuing higher studies	**4**

Audit Courses

Technology + Value Added Course/ Professional & Social + Value Added Course

<table>
<tr><td colspan="3" align="center">KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON
(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-III Audit Course (w.e.f. 2022-23)
AC-301(A): Computer Skills
Credit: 02   Hours of instruction/week: 02
Marks: 100   Total hours of instruction: 60</td></tr>
<tr><td></td><td>Course Objectives:
CO-1. Student will be able to understand various types of literature resources, technical reports.
CO-2. Student will be able to make a technically sound presentation.
CO-3. To learn the Ethics and plagiarism precautions to be taken while doing research.
CO-4. To understand the process of writing research project report and research proposal.
CO-5. At the end of this course, Student will be able to write a technically effective report.</td><td></td></tr>
<tr><td></td><td align="center">Course Contents (Topics and subtopics)</td><td></td></tr>
<tr><td>1</td><td>Elements of Information Technology
1.1 Information Types: Text, Audio, Video, and Image, storage formats
1.2 Components: Operating System, Hardware and Software, firmware
1.3 Devices: Computer, Mobile Phones, Tablet, Touch Screen, Scanner, Printer, Projector,smart boards
1.4 Processor & Memory: Processor functions, speed, Memory types:RAM/ROM/HDD/DVD-ROM/Flash drives, memory measurement metrics</td><td>04 L</td></tr>
<tr><td>2</td><td>Office Automation Text Processing
2.1 Views: Normal View, Web Layout View, Print Layout View, Outline View, Reading Layout View
2.2 Working with Files: Create New Documents, Open Existing Documents, Save Documents to different formats, Rename Documents, Close Documents
2.3 Working with Text: Type and Insert Text, Highlight Text, Formatting Text, Delete Text,Spelling and Grammar, paragraphs, indentation, margins
2.4 Lists: Bulleted and Numbered Lists,
2.5 Tables: Insert Tables, Draw Tables, Nested Tables, Insert Rows and Columns, Move and Resize Tables, Moving the order of the column and/or rows inside a table, Table Properties</td><td>10 L</td></tr>
</table>

	2.6 Page Margins, Gutter Margins, Indentations, Columns, Graphics, Print Documents, 2.7 Paragraph Formatting, Paragraph Attributes, Non-printing characters 2.8 Types of document files: RTF, PDF, DOCX etc	
3	**Office Automation-Worksheet Data Processing** 3.1 Spreadsheet Basics: Adding and Renaming Worksheets, Modifying Worksheets, 3.2 Moving Through Cells, Adding Rows, Columns, and Cells, Resizing Rows and Columns,Selecting Cells, Moving and Copying Cells 3.3 Formulas and Functions: Formulas, Linking Worksheets, Basic Functions, Auto Sum, Sorting and Filtering: Basic Sorts, Complex Sorts, Auto-fill, Deleting Rows, Columns,and Cells 3.4 Charting: Chart Types, drawing charts, Ranges, formatting charts	**10 L**
4	**Office Automation:** 4.1 Create a new presentation, Auto Content Wizard, Design Template, Blank Presentation, Open an Existing Presentation, PowerPoint screen, Screen Layout 4.2 Working with slides: Insert a new slide, Notes, Slide layout, Apply a design template,Reorder Slides, Hide Slides, Hide Slide text, Add content, resize a placeholder or text box, Move a placeholder or text box, Delete a placeholder or text box, Placeholder or Text box properties, Bulleted and numbered lists, Adding notes 4.3 Work with text: Add text and edit options, Format text, Copy text formatting, Replace fonts, Line spacing, Change case, Spelling check, Spelling options 4.4 Working with tables: Adding a table, Entering text, Deleting a table, Changing row width, Adding a row/column, Deleting a row/column, Combining cells ,Splitting a cell,Adding color to cells, To align text vertically in cells, To change table borders,Graphics, Add clip art, Add an image from a file, Save & Print, slide shows, slide animation/transitions.	12 L
5	**Internet& Applications:** 5.1 Computer Network Types: LAN, PAN, MAN, CAN, WAN, Defining and describing the Internet, Brief history, Browsing the Web, Hypertext and hyperlinks, browsers, Uniform resource locator 5.2 Internet Resources: Email, Parts of email, 5.3 Protecting the computer: Password protection, Viruses, Virus protection software,Updating the software, Scanning files, Net banking precautions. 5.4 Social Networking: Features, Social impact, emerging trends, issues, Social Networking sites: Facebook, Twitter, LinkedIn, Orkut, online booking services 5.5 Online Resources: Wikipedia, Blog, Job portals, C.V. writing 5.6 e-learning: e-Books, e-Magazines, e-News papers, OCW(open course wares): Sakshat	08 L

	(NPTEL) portal, MIT courseware	
6	**Cloud Computing Basics** 6.1 Introduction to cloud computing 6.2 Cloud computing models: SAS, AAS, PAS 6.3 Examples of SAS, AAS, PAS (Drop Box, Google Drive, Google Docs, Office 365 Prezi, etc.)	06 L
	References: 1. TCI, "Introduction to Computers and Application Software", Publisher: Jones & Bartlett Learning, 2010, ISBN: 1449609821, 9781449609825 2. Laura Story, Dawna Walls, "Microsoft Office 2010 Fundamentals", Publisher: Cengage Learning, 2010, ISBN: 0538472464, 9780538472463 3. June Jamrich Parsons, Dan Oja, "Computer Concepts Illustrated series", Edition 5,Publisher Course Technology, 2005, ISBN 0619273550, 9780619273552 4. Cloud computing online resources	

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To create new document, work with existing documents.	**2**
2	To acquire skill to insert and resize tables.	**3**
3	To make power point presentation, auto content vizards.	**4**

KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON
(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-III Audit Course (w.e.f. 2022-23)

AC-301(B): Cyber Security

Credit: 02 | **Hours of instruction/week: 02**
Marks: 100 | **Total hours of instruction: 60**

Course Objectives:

CO-1. Student will be able to understand different types of networks

CO-2. Student will be able to understand security concepts.

CO-3. Student will learn about cyber crimes

1	**Networking Concepts Overview** Basics of Communication Systems, Transmission Media, ISO/OSI and TCP/IP models, Network types: Local Area Networks, Wide Area Networks, Internet working, Packet Formats, Wireless Networks: Wireless concepts, Advantages of Wireless, Wireless network architecture, Reasons to use wireless, Internet.	06 L
2	**Security Concepts** Information Security Overview, Information Security Services, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography. Importance of Physical Security, Biometric security & its types, Risk associated with improper physical access, Physical Security equipment. Passwords: Define passwords, Types of passwords, Passwords Storage – Windows & Linux.	14 L
3	**Security Threats and vulnerabilities** Overview of Security threats, Hacking Techniques, Password Cracking, Types of password attacks, Insecure Network connections, Wi-Fi attacks & countermeasures, Information Warfare and Surveillance. Cyber crime: e-mail related cyber crimes, Social network related cyber crimes, Desktop related cyber crimes, Social Engineering related cyber crimes, Network related cyber crimes, Cyber terrorism, Banking crimes,	14 L
4	**Cryptography** Understanding cryptography, Goals of cryptography, Types of cryptography, Applications of Cryptography, Use of Hash function in cryptography, Digital signature in cryptography, Public Key infrastructure,	10 L
5	**System &Network Security** System Security: Desktop Security, email security: PGP and SMIME, Web Security: web authentication, Security certificates, SSL and SET, Network Security: Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems, Overview of Firewalls, Types of Firewalls, VPN Security, Security in Multimedia Networks, Fax Security	06 L
6	**OS Security** OS Security Vulnerabilities updates and patches, OS integrity checks, Anti-virus software, Design of secure OS and OS hardening, configuring the OS for security, Trusted OS.	04 L
7	**Security Laws and Standards** Security laws genesis, International Scenario, Security Audit, IT Act 2000 and its amendments.	06 L

References:

1. Principles of Computer Security,W.A.Cokline, G.White, 4th Edition, McGraw Hills.
2. Cryptography and Network Security Principles and Practices-William Stallings, 7th Edition, Pearson
3. Cryptography and Network Security -William Stallings, 4th Edition, Pearson
4. Cryptography and Network Security- Forouzan Mukhopadhyay, McGraw Hills 2nd Edition.
5. Principles of Information Security- Michael E. Whiteman, Herbert J Mattoral, CENGAGE Learning 4th Edition.
6. Kimberly Graves: CEH-official Ethical Hackeer Guide,Wiley Publishing Inc.2007, ISBN:978-0-7821-4437-6.
7. Shakeel Ali & TediHeriyanto" Backtrack-4Assuring Security by penetration testing PACKT Publishing,2011, ISBN: 978-1-849513-94-4.
8. Understanding Laws- Cyber laws and Cyber-crimes (Lexix Nexis)
9. Cyber Crime Mannual by Bibhas Catterjee, Lawman Publication.

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To understand different types of networks	**2**
2	To acquire skill to use Hash function, digital signature	**3**

	KAVAYITRI BAHINABAI CHAUDHARI **NORTH MAHARASHTRA UNIVERSITY, JALGAON** **(For Affiliated Colleges of KBC NMU)** **Syllabus under CBCS** **M. Sc. Part-II Organic Chemistry** **Semester-III Audit Course (w.e.f. 2022-23)** **AC-301 (C): Molecular Docking** **Credit: 02** **Hours of instruction/week: 02** **Marks: 100** **Total hours of instruction: 60**	
	Course Objectives: CO-1. Student will be able to know about natural products. CO-2. Students will understand structure-based drug design. CO-3. Student will learn about the docking method.	
1	**Introduction drug design and discovery** Introduction: - Natural product, Drugs; principles of drug Development. Bioinformatics in drug development, Chemoinformatics and Pharmacoinformatics. Applications of Drug Discovery and In-Silico Drug Designing,Area influencing drug discovery; Molecular Biology, pharmacogenomics and pharmacoproteomics	20 L
2	**Structure-based drug designing** Introduction, Structure-based drug designing approaches: - Target Identification and Validation, homology modeling and protein folding, receptor mapping, active site analysis and pharmacophore mapping, Grid maps.	20 L
3	**Ligand-based drug designing and docking** 4.1 Introduction, Ligand-based drug designing approaches: Lead Designing, combinatorial chemistry, High Throughput Screening (HTS), QSAR, Database generation and Chemical libraries, ADME property. 4.2 Introduction to docking methods to generate new structure; Tools and Molecular docking programs: Auto Dock, Dock, HEX **References:** 1. The Pharmacological Basis of Therapeutics, Louis S.Goodman, Alfred Gilman Sr.,Edited by Laurence L.Brunton, John S.L., K.L.Parkar,McGraw HillEducation,11th Edition (2005). 2. Oxford Textbook of Clinical Pharmacology and Drug Therapy, D.G.Grahame-Smith and J.K.Aronson, Oxford University Press, 3rd Edition (2002). 3. Organic Chemistry of drug design and drug action, R,B.Silverman, Academic Press, 2nd Edition (2004). 4. Statistical Methods in Biology, Bailey M. A., Norman T. J., Cambridge University Press, 3rd Edition (1995). 5. A Text book of Drug design and development, Povl. Krogsgaard-Larsen Tommy L. and U Madsen, CRC Press,2nd Edition (1996).	20 L

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To understand the principle of drug development.	**2**
2	To identify target and its validation, incase of structure based drug design	**3**

KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON
(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-IV Audit Course (w.e.f. 2022-23)

AC-301 (D): Technical Report Writing

Credit: 02 | **Hours of instruction/week: 02**
Marks: 100 | **Total hours of instruction: 60**

	Course Objectives: To make the students familiar with the, CO-1. Student will be able to understand various types of literature resources, technical reports. CO-2. Student will be able to make a technically sound presentation. CO-3. To learn the Ethics and plagiarism precautions to be taken while doing research. CO-4. To understand the process of writing research project report and research proposal. CO-5. At the end of this course, Student will be able to write a technically effective report.	
	Course Contents (Topics and subtopics)	
	Literature Resources, Writing Scientific Reports, Scientific Paper and Writing a Scientific Paper	
1	**Literature Resources:** Introduction of Print and Digital Literature Resources, Sources of Information, Types of Literature: Primary, Secondary, and tertiary sources of Information, Types of Journals, Literature Review, Need for Literature Review, Writing a Literature Review, Conference Proceedings, Journal Impact Factor, *h*-index, and Citation Index. Seminar Conference and Workshop. Shodhganga: a reservoir of Indian Theses. **Ref.: Ref. - 1: Pages: 149-177; Ref. – 2.**	**20 L**
2	**Writing Scientific Reports:** Introduction, Types of Scientific Reports, General Rules for Scientific Writing, Synopsis Writing, Progress Report, Formats for Report Writing, Reporting Practical and Project work, Research Proposal, Referencing. Introduction of Plagiarism, Reading Research Paper. Scientific work presentation, Organizing a Poster display, Oral Presentation, Resume, Curriculum Vitae, A Comparison between a Resume, Curriculum Vitae. Ref.: Ref. - 1: Relevant Pages; Ref. – 3: Pages: 85-107, 209-232, Ref. 5: 344-360.	**20 L**
3	**Scientific Paper and Writing a Scientific Paper:** Introduction of Scientific Paper, Title, Abstract, Keywords, Introduction, Materials and Methods, Result and Discussion, Conclusion, Acknowledge and References. Introduction to writing a scientific paper, Importance of Scientific Writing, Characteristics of Scientific Writing, Duties and Responsibilities of Authors, Communicating to a Journal,	**20 L**

	Submission Methods, Peer Review: Single Blind Review, Double Blind Review and Open Review. **Ref.: Ref. – 1: Pages: 180-208.; Ref. – 4: 325-354, Ref. 5: 344-360.**	
	References: **1.** Research Methodology for Scientific Research, K. Prathapan, I. K. International Pvt. Ltd., New Delhi (2019). **2.** https://shodhganga.inflibnet.ac.in/ **3.** Advanced Manual for Communication Laboratories and Technical Report Writing, D. Sudha Rani, Dorling Kindersley (India) Pvt. Ltd, Pearson Education in South Asia, New Delhi 110 017, India (2012). **4.** Practical Skills in Chemistry, 2nd Ed, Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. and Jones, A. Prentice-Hall, Harlow (2011). **5.** Research Methodology: Methods and Techniques, 3rd edition, Kothari, C.R. Published by New Age International (P) Ltd., Publishers (2004). **6.** APPENDIX A: The Literature of Organic Chemistry March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Seventh Edition, by Michael B. Smith and Jerry March Copyright John Wiley & Sons, Inc. (2013). **7.** Research Methodology, G. H. Sonawane, H. A. Mahajan, H. R. Talele, S. S. Rajput, S. D. Yeole, S. L. Sonawane, Prashant Publications (2020).	

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To be able to write comprehensive literature review, project or scientific reports on a given research topic.	**2**
2	To follow the ethical guidelines while doing research avoid plagiarism in thesis and research publications.	**3**
3	To be able to present and communicate their scientific work as well as ideas to scientific community.	**2**
4	To utilize the gained knowledge or skills in the scientific research and build his/her career in chemistry research field	**2**

	KAVAYITRI BAHINABAI CHAUDHARI **NORTH MAHARASHTRA UNIVERSITY, JALGAON** **(For Affiliated Colleges of KBC NMU)** **Syllabus under CBCS** **M. Sc. Part-II Organic Chemistry** **Semester-IV Audit Course (w.e.f. 2022-23)** **AC-401 (A): Human Rights** **Credit: 02** **Hours of instruction/week: 02** **Marks: 100** **Total hours of instruction: 60**	
	Course Objective To impart the basic ideas about Human Rights at post graduations level. This paper provides different aspects of human rights which includes children and women. Students can learn not only their basic rights bus also can understand the duties to be carried out in the days to come.	
1	**An Introduction to Human Rights** 1.1: Values – Dignity, Liberty, Equality, Justice, Unity in Diversity 1.2: Human Rights – Meaning and features; Significance of the study 1.3: Classification of Human Rights 1.4: Rights and Duties – Correlation	10 L
2	**Human Rights of Vulnerable Groups:** 2.1: Women's Rights 2.2: Rights of the Child 2.3: The Rights of Persons Belonging to Minorities 2.4: Rights of Refugees and Migrant Workers 2.5: Indigenous People and Human Rights 2.6: Human Rights of Prisoners 2.7: Rights of Physically Disabled	14 L
3	**Human Rights in India** 3.1: Human Rights and Fundamental Rights 3.2: Fundamental Rights and Fundamental Duties 3.3: Directive Principles 3.4: Role of Judiciary in the protection of Human Rights	12 L
4	**Protection and promotion of Human Rights in India** 4.1: National Human Rights Commission – Composition and functions 4.2: Human Rights and NGOs 4.3: Human Rights and Media	12 L
5	**Issues and concerns in Human Rights** 5.1: Changing dimensions of Human Rights 5.2: Challenges to Human Rights promotion in India-Poverty, Illiteracy, Communal and caste conflicts, patriarchal values, lack of inclusive development 5.3: Human Rights and Terrorism 5.4: Human Rights and problems of health and environment	12 L
	References : 1. "Protect Human Rights", http://www.un.org/en/sections/what-we-do/protect-human-rights/index.html 2. Aftab Alam, ed., Human Rights in India: Issues and Challenges, Delhi; Raj Publications., 2012 3. D.D. Basu, Human Rights in Constitutional Law, Gurgaon; Lexis Nexis, 2008 4. Upendra Baxi, The Future of Human Rights, New Delhi; OUP India, 2012 5. Andrew Clapham, Human Rights A Very Short Introduction, Oxford; OUP, 2015	

6. Human Rights by S. Subrahmanyam
7. M.P.Dube and Neeta Bora, eds., Perspectives on Human Rights, Delhi; Anamika Pub., 2000
8. Manisha Priyam, Krishna Menon and Madhulikea Banerjee, Human Rights, Gender and the Environment, Chennai; Pearson Education, 2009
9. K.P. Saksena, ed.,Human Rights and the Constitution: Vision and Reality,, New Delhi; Gyan Pub., 2003
10. K.S. Pavithran, Human Rights in India: Discourses and Contestations, New Delhi; Gyan Pub., 2018
11. H.O. Agarwal, Human Rights, Allahabad: Central Law Pub., 2016
12. Baradat Sergio and Swaronjali Ghosh. Teaching of Human Rights : Dominant Publishers and distributors, New Delhi,2009.
13. Asish Kumar Das and Prasant Kumar Mohanty, Human Rights in India, New Delhi; Sarup & Sons, 2007
14. C.J. Nirmal, Human Rights in India, Historical, Social and Political Perspectives, New Delhi, OUP, 2002

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	Understand the importance and different approaches to Human rights.	**2**
2	Understand the different Constitutional provisions and legislation to protect Human rights in India.	**3**
3	Examine the challenges to Human Rights of different vulnerable sections.	**2**
4	Understand the issues concerning the rights of citizens in general.	**2**

KAVAYITRI BAHINABAI CHAUDHARI
NORTH MAHARASHTRA UNIVERSITY, JALGAON
(For Affiliated Colleges of KBC NMU)
Syllabus under CBCS
M. Sc. Part-II Organic Chemistry
Semester-IV Audit Course (w.e.f. 2022-23)

AC-401 (B): Seminar on Review of Research Paper

Credit: 02 — **Hours of instruction/week: 02**
Marks: 100 — **Total hours of instruction: 60**

	Course Objectives: CO-1. Students will learn how to do the referencing. CO-2. Students will understand how to write the review of literature.	
1	Select a topic for research duly in consultation with his/her guide.	10L
2	Identify the appropriate databases for literature survey and compile a working bibliography adopting standard referencing style.	20L
3	Prepare a comprehensive and critical review of the literature highlighting the growth, development, evolution and landmarks in the area of research. The review should result in identification of gaps in the existing literature and should form the basis to present the novelty, significance and need for the study. The objective, methodology and findings of the earlier studies shall be examined in the context of the research topic chosen by the researcher.	20L
4	Present the literature review report in the form of a seminar and submit the same to be evaluated by the Department Council.	10L
	Suggested Studies: 1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) 2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press Model Curriculum of Engineering & Technology PG Courses [Volume -II] 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book. 4. Adrian Wall work , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011	

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	To select the topic for research in consultation with guide.	**2**
2	To present the literature review in the form of seminar.	**3**

	KAVAYITRI BAHINABAI CHAUDHARI **NORTH MAHARASHTRA UNIVERSITY, JALGAON** **(For Affiliated Colleges of KBC NMU)** **Syllabus under CBCS** **M. Sc. Part-II Organic Chemistry** **Semester-IV Audit Course (w.e.f. 2022-23)** **AC-401 (C): Current Affairs** **Credit: 02** **Hours of instruction/week: 02** **Marks: 100** **Total hours of instruction: 60**	
	Course Objective: Students will be expected to display general knowledge of history, politics and International Affairs, as deemed necessary to interpret current affairs.	
	• **Current Affairs: Global Issues** o International Security o International Political Economy o Human Rights o Environment: Global Warming, Kyoto Protocol, Copenhagen Accord o Population: world population trends, world population policies o Terrorism and Counter Terrorism o Global Energy Politics o Nuclear Proliferation and Nuclear Security o Nuclear Politics in South Asia o Millennium Development Goals, Current Status, o Globalization o Middle East Crisis o Kashmir Issue o Palestine Issue	60 L

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	**CO**	**Cognitive level**
1	Understand effect of greenhouse gases.	**2**
2	To understand the reasons of Crisis and the solutions.	**3**

	KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON (For Affiliated Colleges of KBC NMU) Syllabus under CBCS M. Sc. Part-II Organic Chemistry Semester-IV Audit Course (w.e.f. 2022-23) AC-401 (D): Intellectual Property Rights **Credit: 02** **Hours of instruction/week: 02** **Marks: 100** **Total hours of instruction: 60**	
	Course Objectives: ✤To acquaint the learners with the basic concepts of Intellectual Property Rights. ✤To develop expertise in the learners in IPR related issues and sensitize the learners with the emerging issues in IPR and the rationale for the protection of IP	
1	**Introduction** Introduction to IPRs, Basic concepts and need for Intellectual Property – Meaning and practical aspects of Patents, Copyrights, Geographical Indications, IPR in India and Abroad. Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.	12 L
2	**Intellectual Property Rights** The IPR tool kit, Patents, the patenting process, Patent cooperation treaties: International Treaties and conventions on IPRs: Trade Related Aspects of Intellectual Property Rights Agreement, Patent Cooperation Treaty, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act	12 L
3	**Intellectual Property Protections** IPR of Living Species, protecting inventions in biotechnology, protections of traditional knowledge, biopiracy and documenting traditional knowledge, Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection. Case studies: The basmati rice issue, revocations of turmeric patent, revocation of neem patent.	12 L
4	**Exercising and Enforcing of Intellectual Property Rights** Rights of an IPR owner, licensing agreements, criteria for patent infringement. Case studies of patent infringement, IPR – contract, unfair competitions and control, provisions in TRIPS,	12 L
5	**Role of Patents in Product Development & Commercialization** Recent changes in IPR laws impacting patents and copy rights, intellectual cooperation in the	12 L

	science and allied industry. Patentable and non-patentable research. Case studies	
	References 1. P.B. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy. Tata Mc Graw Hill, 2001. 2. Steve Smith, The Quality Revolution.1st ed., Jaico Publishing House, 2002. 3. Kompal Bansal and Praishit Bansal. Fundamentals of IPR for Engineers, 1st Edition, BS Publications, 2012. 4. Prabhuddha Ganguli. Intellectual Property Rights. 1st Edition, TMH, 2012. 5. R Radha Krishnan & S Balasubramanian. Intellectual Property Rights. 1st Edition, Excel Books, 2012. 6. M Ashok Kumar & Mohd. Iqbal Ali. Intellectual Property Rights. 2nd Edition, Serial Publications, 2011. 7. VinodV. Scople, Managing Intellectual Property. Prentice Hall of India PvtLtd, 2012. 8. Deborah E. Bouchoux. Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets. Cengage Learning, 3rd 9. Prabuddha Ganguli. Intellectual Property Rights: Unleashing the Knowledge Economy. McGraw Hill Education, 2011. 10. Edited by Derek Bosworth and Elizabeth Webster.The Management of Intellectual Property. Edward Elgar Publishing Ltd., 2013. 11. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House	

Course Outcomes (COts):

Upon the completion of course, the student should be able:

CO No.	CO	Cognitive level
1	to understand the concept of intellectual property Rights, its protection.	**2**
2	To know the latest changes made in Intellectual Property Rights.	**2**

PATIL VILAS SHRIPATI

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