SYLLABUS

AS PER NEP 2020

MULTIPLE ENTRY AND EXIT IN ACADEMIC PROGRAM

OFFERED IN HIGHER EDUCATION INSTITUTIONS

SCHOOL OF SCIENCES

MATS University, Raipur

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2024-28

B.Sc. Microbiology

Prog. Code:

Three Year Full Time Bachelor's Degree

(Program duration: Three years or six semesters)

And

Four Year Full Time Bachelor's Degree (Honors/Research)

(Program duration: Four years or eight semesters)

Syllabus B.Sc. Microbiology (Prog Code:)

Three Year and Four Year Bachelor' Degree (Honors/ Research)

GENERAL INTRODUCTION OF THE DEPARTMENT

MATS School of Sciences (MSS) was established with a vision to create technocrats in the applied branches of Sciences to convey updated scientific knowledge. In the school theperformances of the students are constantly monitored by continuous assessment. The School believes in supplementing academic input of students with the help of regular Seminar, Guest Lectures, Industrial/Research Institute visits and encouraging the students to participate in National & International Seminars, Conferences and Workshops.

DEPARTMENT HIGHLIGHTS

- Research focus on frontier of Life Sciences and affordable healthcare
- Highly acclaimed scientists as faculty
- State-of-the-art Lab facilities
- Hand-on training on sophisticated equipments
- Academia – Industry interface
- Multidisciplinary research in affordable healthcare, Agriculture and Food

COURSEDESIGN

The department follows a unique course-design which is contemporary and cutting-edge. It includes modern and advanced papers/ subjects including the papers from Management Science as given in the curriculum matrix

PEDAGOGY

- Chalk Board, LCD and Projector based teaching
- Research based teaching
- Project based learning
- Separate lab bench for each student

FACILITIES

State-of-the-art facilities include:

- Double beam UV- Visible Spectrophotometer, Cooling Centrifuge, Microfuge, Incubators, Microscopes, Laminar flow hoods, Colorimeter, Micro- and regular balance, Electronic Balance Autoclave, Glass distillation apparatus, Computers, Deep freeze, pH meter, conductivity meter, DNA/RNA & Protein Electrophoresis apparatus, Plant Tissue Culture racks with light arrangements, Shakers, BOD incubator & Orbital Shaking Incubator etc
- Microbial cell culture
- Plant tissue culture

FACULTIES

- Well experienced faculties from Academic Institutes and Industries
- Invited lectures by eminent scientists from different countries

B. SC. BIOLOGY: SCOPE AND CONTENT

Biology is the research-oriented science. This study includes a large variety of subjects including Cell biology & Genetics, Plant Diversity, Chemistry, Animal Sciences, Plant Sciences, Environmental Studies, Computer applications, Genetic Engineering, Inheritance Biology, Poultry Farming, Biostatsitics, Research Methodolgy, Communication and IT Skills, Entrepreneurship, Languages English & Hindi, Principles of Management, Anatomy, Physiology & Reproductive Biology, Principles of Marketing Project work etc.

OBJECTIVES OF THE B.Sc. BIOLOGY PROGRAM (Three Years and Four Year (Research/Honors))

1. To impart basic knowledge and skills of various aspects of biology.
2. To train the students for industrial need and to pursue further education.
3. To develop human resource and entrepreneurs in biology with the ability to independently start their own ventures.
4. Understand modern biology - practices and approaches with an emphasis in biology application in pharmaceutical, medical, industrial, environmental and agricultural areas.
5. Become familiar with issues related to biology nationally and globally
6. Gain experience with standard biological tools.
7. Develop skills in teamwork.

ELIGIBILITY FOR ADMISSION:

Interested aspirants for B.Sc. Biology degree need to fulfill the below mentioned eligibility criteria.

- Completion of Higher Secondary (10+2) level of education.
- Physics, chemistry and biology as main subjects at HSC level
- Instead of biology, one may even have had any subject related to biological sciences as one of the mainsubject of study.

CAREER PROSPECTS:

B.Sc. Biology-Bachelor of science in Biology (chemistry, botany and zoology). This course enables the students to take up advanced studies in Chemistry, Botany, and Zoology and can find opportunities in all these subject areas. On successful completion of the B.Sc. Biology programme students will be able to provide a comprehensive understanding of fundamentals of chemical sciences and biological sciences. They will also be able to express proficiency in oral and written communications to appreciate innovation in research. understand the impact of chemicals in societal and environmental contexts, apply ethical principles and responsibilities while conducting animal studies, understand the biodiversity and apply the knowledge to conserve endangered species and develop industry-focused skills to lead a successful career.

THE MAIN JOB SECTORS ARE AS FOLLOWS:

Health service organizations, Pharmaceutical companies, Universities and Research institute, Horticultural industries, Conservation organizations, Food and drink manufacturers, Water industry, Agricultural industry, Law Enforcement, Poultry industry, Sericulture and Pisciculture Industry.

ATTENDANCE:

A candidate shall be deemed to have undergone a regular course of study in the University, if he/she has attended at least 60% of the lectures in each subject will be at least 75% in the aggregate of lectures, tutorials and practical in order to be eligible to appear at the Final Examination.

SCHEME OF EXAMINATION, EVALUATION AND DISTRIBUTION OF MARKS:

1. The overall weightage of a course in the Syllabi and Scheme of Teaching & Examination shall bedetermined in terms of Marks assigned to the course.
2. The evaluation of students in a course shall have two components unless specifically stated otherwise inthe Scheme of Teaching & Examination and Syllabi:

(i) Evaluation through a semester-end examination (University Examination Marks)
(ii) Continuous evaluation by the teacher(s) of the course.

		Bachelor's degree/ Under-graduate diploma	Master's degree/ Post-graduate diploma
A.	**THEORY COURSES**		
	(i) Semester-end examination	70%	70%
	(ii) Continuous evaluation by the teachers	30%	30%
B.	PRACTICAL/LABORATORY COURSES		

	(i) Semester-end examination	70%	70%
	(ii) Continuous evaluation by the teachers	30%	30%
C.	DISSERTATION/THESIS		
	(i) Assessment by External Examiner	70%	70%
	(ii) Assessment by Internal Examiner	30%	30%

CONTINUOUS EVALUATION (INTERNAL MARKS)

(i) Theory courses

The division of internal marks will of 50% marks for mid semester examination and 50% of marks for the internal class tests. There shall be three class tests held during each semester. These class tests shall ordinarily be held after 4 weeks, 8 weeks and 12 weeks of teaching in accordance with the University Academic Calendar.

(ii) Practical/Laboratory courses

The total internal marks in practical /Laboratory courses shall be based on performance in the laboratory, regularity, practical exercises /assignments, quizzes, etc. The assessment shall be given at three nearly equi-spacedintervals.

PASSING MARKS:

For undergraduate students, obtaining a minimum of 40% marks in aggregate in each course shall be essential for passing the course and earning its assigned credits. A candidate, who secures less than 40% of marks in a course, shall be deemed to have failed in that course.

GRADING SYSTEM:

For UG:

80% and above – "10 Grade Point" and Letter Grade "O" (Outstanding)
40% and above but below 45% - "Grade Point 4" and Letter Grade "P" (Pass)

For PG:

80% and above – "10 Grade Point" and Letter Grade "O" (Outstanding)
45% and above but below 50% - "Grade Point 4" and Letter Grade "P" (Pass)

PROGRAM DURATION:

The maximum permissible period for completing a program for which the prescribed program duration is **n semesters**, shall be **(n+4)** semesters. All the program requirements shall have to be completed in (n+4) semesters.

ATKT CRITERIA:

ATKT Candidate means a candidate who failed in not more than forty percent of the total number of Core and Corebracket papers, excluding the Practical Examination / Project Work / Viva Voce Examination in the Semester Examination and is appearing in the Examination of same semester again which is organized with the next Semester Examination. Forty percent will be rounded off to higher side in case it is not a whole number. In case a Students fails or was absent in Practical Examination / Project Work / Viva Voce Examination, he/she may be allowed to have ATKT exam on his/her own expenses.

Semester Pattern

Programme: Bachelor of Microbiology (B.Sc) Sem: I							
NHEQF Level: 5 | Courses					Evaluation Scheme		Total Marks
Course Category	Course Sub Category	Course Name	Code	Credits	CIA	ESE	
Discipline Specific Core Course Core (DSCC)	Major	Microbio-I: General Microbiology		3	70	30	100
	Major	Bioscience-I: Plant Diversity		3	70	30	100
	Major	Fundamental Chemistry I		3	70	30	100
Discipline Specific Core Practical (DSCCP)	Major	Microbiology Lab - I		1	35	15	50
	Major	Bioscience Lab - I		1	35	15	50
	Major	Chemistry Lab - I		1	35	15	50
General Elective Inter/Multidisciplinary/ Allied Courses (GEC)	GEC	**Nutrition for Health**		4	70	30	100
Ability Enhancement Course (AES)	AES	Communication Skill		2	35	15	50
Skill Enhancement Course (SEC)	SEC	Instrumentation and System Biology		2	35	15	50
Value Added Course (VAC)	VAC	Yoga and Meditation		2	35	15	50
				22	**490**	**210**	**700**

FIRST SEMESTER

Microbio I: General Microbiology

THEORY

Credit: 3
Total Marks: 100 (70+30)

Module I

Introduction to Microbiology: Historical Background and Scope of Microbiology, Structure of Prokaryotic cells, Morphology and ultra-structure of Bacteria (Flagella, Pili, Cell-wall, spores and nuclear material)
Sterilization techniques: Dry heat, wet heat, radiation, filtration and chemicals. Growth: Measurements, dry weight, colony count, packed cell volume, turbidometry,

Module II

Classification of Bacteria: Basic principle and techniques used in bacterial classification. Generalclassification and reproduction of bacteria
Culture media: Types and preparation.
Culture Technique: Isolation of pure culture (spread plate, streak, pour plate). Staining techniques**.**Different techniques for Isolation of Microbes.

Module III

Microbial metabolism: Role of ATP in metabolism, aerobic and anaerobic respiration, Assimilation of ammonia, nitrate, molecule Nitrogen and sulphate, Fermentation.
Microbial Ecology: Microbial flora of soil, Interaction among soil microorganisms.

Module IV

Eukaryotic Microbes: Fungi- salient features, structure of fungal cell, classification, Reproduction, Fungi of economic importance. Type study- Penicillum, Aspergillus, Yeast, Rhizopus. Protozoa- General Features. Classification and economic importance, entamoeba, trypanosoma, Plasmodium.

Module V

Viruses: General account of virus structure, classification of viruses, virus of plants, animals and bacteria,Various types of viral genomes- double stranded DNA genomes, single stranded RNA genomes, double strands RNA genome, single stranded DNA genomes. Viroids and prions**.**

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Practicals

1. **Microbiology Techniques**
   - (a)Basic operations in laboratory
   - (b) Documentation: The Lab Notebook & Lab Report
   - (c) Lab Equipment & Reagent Orientation
2. **Preparation of media and cultivation Techniques**
   - (a) Basic liquid media (broth)
   - (b) Basic Solid media
   - (c) Isolation and enumeration of micro organisms from air, water and Soil

3. Smears and Staining Methods

(a) Preparation of bacterial smear
(b) Gram Negative & Positive staining

4. Methods of obtaining pure cultures

(a) Streak plate method
(b) Pure plate method
(c) Spread plate method
(d) Broth cultures

Suggested Readings

1. Gereld Karp - Dell and molecular biology, 4th Edition (2005)
2. C.B. Powar- Cell biology, First Edition (2005), Himalaya Publishing House.
3. Microbiology Fundamentals and Application by S. S. Purohit
4. Seidman & Moore, Basic Laboratory Methods for Microbiology: Textbook & Laboratory Reference,
5. Laboratory security: http://ehs.uky.edu/ohs/labsecurity.html
6. Basic Laboratory Methods for Microbiology, by Lisa A. Seidman & Cynthia J. Moore. Prentice Hall
7. Pelczar MJ, Chan ECS and Krieg NR. Microbiology. McGraw Hill Book Company.
8. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR.General Microbiology. 5thedition. McMillan.
9. Prescott, Harlyey and Klein - Microbiology, Third Edition, Wm. C. Brown Publishers (1996).
10. R.C. Dubey and D.K. Maheshwari,Microbiology (2006). S.Chand Publication.
11. Elements of Human Genetics. I.I. cavalla-Sfoeza, WA Benjamin Advanced Book Program.
12. R.C. Dubey and D.K. Maheshwari: Practical Microbiology. S.Chand Publication.

Botany I: Plant diversity

THEORY ()

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of plant diversity.
2. To train the students to pursue further education.
3. Become familiar with bioscience tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Plant Diversity and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
4. Ability to dissect a problem in to its key features.

UNIT -I

Bacteria and Viruses: General account of bacteriastructure; nutrition,

reproduction and economic importance; general account of cyanobacteria. General account of viruses and mycoplasma;

UNIT –II

Fungi: General characters, classification, important features and life history of Mastigomycotina – *Phytophthora*; Zygomycotina – *Mucor*; Ascomycotina – *Saccharomyces*; Basidiomycotina – *Puccinia*; Deuteromycotina – *Colletotrichum*; geneneral account of Lichens. Economic importance of fungi.

UNIT -III

Algae: General characters, classification, important features and life history of Chlorophyceae – *Volvox*, *Oedogonium*; Xanthophyceae – *Vaucheria*; Phaeophyceae – *Ectocarpus*; Sargassum Rhodophyceae – *Polysiphonia*. Economic importance of algae.

UNIT –IV

Bryophyta: Outlines of classification and importance of bryophytes. Structure, reproduction and classification of Hepaticopsida (*e.g. Riccia Marchantia*); Anthocerotopsida (*Anthoceros*), Bryopsida (*Funaria*).

UNIT –V

Pteridophyta: Important characteristics of Psilopsida, Lycopsida, Sphenopsida and Pteropsida; Structure, reproduction in *Rhynia, Lycopodium, Selaginella, Equisetum* and *Marsilea*.

SUGGESTIVE READINGS

1. Introduction to Botany – Bendre & Kumar
2. Botany for Degree Students – Algae: Vashishtha *et al*.
3. Botany for Degree Students – Bryophyta: Vashishtha et al.
4. An introduction to Pteridophyta – A. Rashid
5. Angiosperms: G. L. Chopra
6. Plant Taxonomy: O. P. Sharma

CHEMISTRY
Theory ()

Credit: 3
Total Marks: 100 (70+30)

Course Objectives:

1. To impart basic knowledge of chemistry.
2. To train the students to pursue further education.
3. Become familiar with chemical tools.

Course Outcome:

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals Chemistry and key principles of it.
2. Awareness of the major issue at the forefront of the discipline.
3. Good quantitative skills such as the ability to accurately and reproducibly prepare reagents for experiments.
4. Ability to dissect a problem in to its key features.

Module I

Chemistry in Ancient India:

Chemical techniques in ancient India: General Introduction (b) Contribution of ancient Indian scientists in chemistry. e.g. Metallurgy dyes, pigments cosmetics, Ayurveda, Charak Sanhita.

Ancient Indian Chemist: Their contribution and Books –Rishi Kanad, Acharya Nagarjuna, Vagbhatta, Govindacharya, Yashodhar Ramchadra, Somadava, Gopalbhatta. etc. Indian Chemistry of 19th centuary –Aacharya Prafulla Chandra Ray- His Contribition and work for the Indian Chemistry.

(B) Atomic Structure and Periodic Properties: (i) Review of Bohr's theory and its limitation. Dual nature of particle and waves, de Broglie's equation, Heisenberg Uncertainty principle and its significance, (ii) Quantum numbers and its significance, Rules for filling electrons in various orbitals, Pauli Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals. Anomalous electronic configurations (iii) Effective nuclear charge (ENC), shielding or screening effect, Slater rules, Atomic & Ionic radii. Ionization energy and factors affecting ionization energy. Electron affinity. Electronegativity----Pauling's /Milliken's electronegativity scales. Relation of electronegativity with hybridization.

Module II

Chemical Bonding I

Ionic Bonding: General characteristics of ionic bonding. Ionic bonding& Energy: Lattice and solvation energies and their importance in the context of stability and solubility of ionic compounds, Born-Haber cycle and its Applications: Covalent character in ionic compounds, polarizing power & polarizability. Fajan's rules.

Covalent Bonding: Lewis structure, Valence bond theory, Hybridization, dipole moment and percentage ionic character, Valence shell electron pair repulsion (VSEPR).

Chemical Bonding II

MO Theory: LCAO method –criteria of orbital overlapping, types of molecular orbitals σ-, π- and δ-MOs; formation of σ- and π- MOs and their schematic illustration: qualitative MO energy diagram of homo and hetro-diatomic molecules, magnetic properties, bond order and stability of molecules and ions.

Weak Chemical Forces: Vander Waals forces, ion- dipole forces, dipole-diploe interactions, ion-induced dipole interactions dipole–induced dipole interactions. Repulsive forces, Hydrogen bonding.

Module III-

Chemical Properties of s-Block metals: Reaction with water, air, and nitrogen, Anomalous behaviour of Li and Be, Compounds of s- block metals: Oxides, Hydroxides, peroxides and superoxides. Complexes of s- block metals, Complexes with Crown ethers

Chemistry p -Block Elements: Boron group: Hydrides, Diboranes, Borazine, Carbon groups: Carbides, Silicates, Nitrogen Groups: Hydrides of Nitrogen, Structure of oxides of nitrogen, Structure of oxyacids of nitrogen, Nitrides, Structure of Oxides and oxoacids of Phosphorus. Halogen: Hydrides, Oxides and oxyacids of halogens -Interhalogen compounds and pseudo halogens

Module IV-Electronic Effects in Organic Compounds

Bond Cleavage: Homolytic and heterolytic cleavage, bond energy, bond length and bond angle. Electron Displacement Effects: Inductive, inductomeric, electrometric, mesomeric, hyper conjugation, and steric effects. Tautomerism. Reaction Intermediates: Formation and stability of carbocations, carbanions, free radicals, carbenes, nitrene and benzyne.

Stereochemistry of Organic Compounds

(i) Optical Isomerism: Elements of symmetry, chirality, enantiomers, and optical activity, Chiral and achiral molecules with two stereo genic centres, Erythro & Threo, Diastereomers and meso compounds, Inversion, retention and racemization, relative configuration (D/L), and absolute configuration (R/S) nomenclature: sequence rules).

(ii) Geometrical Isomerism: Geometric isomerism (cis-trans isomerism) in alkenes, E/Z system of nomenclature.

SUGGESTIVE READINGS

1. Basic Inorganic Chemistry, F.A Cotton, G. Wilkinson and P.L Gauss, Wiley.
2. Concise Inorganic Chemistry, J.D. Lee, ELBS.
3. Concepts of models of Inorganic Chemistry, B. Douglas, D. Mc Daniel and JAlexander, John Wiley.
4. Inorganic Chemistry, W. W. Porterfield, Addison- Wesley.
5. Inorganic Chemistry, A.G. Sharp, ELBS.
6. Inorganic Chemistry, G.L. Missiles and D.A. Tarr, Prentice Hall.
7. Advanced Inorganic Chemistry, Satyas Prakash.
8. Advanced Inorganic Chemistry, Agarwal & Agarwal.
9. Introduction to Organic Chemistry, Struiweisser, Heathock and Kosover, Macmillan.
10. Advanced Inorganic Chemistry, Satyas Prakash.
11. Advanced Inorganic Chemistry, Agarwal & Agarwal.
12. Advanced Inorganic Chemistry, Puri & Sharma, S. Naginchand.
13. Organic Chemistry, P.L. Soni.
14. Organic Chemistry, Bahl & Bahl
15. Organic Chemistry, .Joginder Singh.
16. Organic Chemistry, EA. Carey, MC Graw HiII
17. Organic Chemistry, Vol. I, II & III, S.M. Mukherjee, S.P. Singh and R.P. Kapoor,Wiley-eastern (New-Age).

Nutrition for Health
Theory (01CBZ1103)

Credit: 3
Total Marks: 100 (70+30)

UNIT 1 Basic concepts in food and nutrition

- Basic terms used in study of food and nutrition
- Understanding relationship between food, nutrition and health
- Balanced diets, micro and macro nutrients
- Functions of food-physiological, psychological and social

UNIT II Nutrients

• Functions, dietary sources and clinical manifestations of deficiency/ efficiency of the following nutrients: Carbohydrates, Lipids, Proteins, Milk & Milk products and Food Groups. • Type 2 Diabetes • Hypertension • Obesity CHD

• Fat soluble vitamins-A, D, E and K

• Water soluble vitamins – Thiamin, Riboflavin, Niacin, Pyridoxine, Folate, Vitamin B_{12} and Vitamin C

• Minerals – Calcium, Iron, Iodine and Zinc

UNIT III: Food Adulteration

• PFA definition of food adulteration

• Adulterants in commonly consumed food items

• Accidental contamination: botulism, staphylococcal and aflatoxin intoxication

• Importance of food labels in processed foods and nutritional labelling

• Food laws, regulations and standards - Codex Alimentarius - Prevention of Food Adulteration (PFA) Act - Agmark - Fruit Products Order (FPO) - Meat Products Order (MPO) - Bureau of Indian Standards (BIS) - MMPO – FSSAI

UNIT IV:Nutritional problems, and related nutrition programmes

• Etiology, prevalence, clinical features and preventive strategies of- Under nutrition

• National Nutrition Policy and Programmes - Integrated Child Development Services (ICDS) Scheme, Mid day Meal Programme (MDMP), National

programmes for prevention of Anaemia, Vitamin A deficiency, Iodine Deficiency Disorders.

INSTRUMENTATION & SYSTEM BIOLOGY

(Skill Enhancement Course (SEC))

Credit: 2
Total Marks: 50 (35+15)

Course objectives

1. To impart basic knowledge related to instrumentation.
2. To train the students to pursue further education.
3. Become familiar with the instrumentation.
4. Gain experience with standard tools.

Course Outcome

Skills that students obtain after completion of the course:

1. Understanding of the fundamentals of instrumentation and key principles of its.
2. Awareness of the major issue at the forefront of the discipline.
3. Ability to dissect a problem in to its key features.
4. Ability to design experiments and understand the limitations of the experimental approach.

UNIT I:

An introduction to instrumental methods: Terms associated with Biochemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation.

UNIT II:

Microscopy – Instrumentation, Technique & Principle of Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase contrast microscopy, TEM & SEM.

UNIT III:

Chromatography - Concept of Chromatography (Partition Chromatography, Paper Chromatography, Adsorption Chromatography, TLC, GLC, Ion Exchange Chromatography, Gel Chromatography, HPLC, Affinity Chromatography).

UNIT IV:

Electrophoresis - Instrumentation, Technique & Principle of Gel Electrophoresis & Paper Electrophoresis.

UNIT V:

Spectroscopy - Absorption Spectroscopy: Simple theory of the absorption of light by molecules, Beer-Lambert law, Instrumentation for measuring the absorbance of visible light, Factors affecting the absorption properties of a Chromophore.

LAB COURSE I
BOTANY ()

Total Marks: 50 (35+15)

BOTANY I: PLANT DIVERSITY LAB

1. Disease Symptoms/Gram's Staining
2. Study of different algae, with the help of permanent slides and also by cuttingsections
3. Study of different Fungi, with the help of permanent slides and also by cuttingsections
4. Study of different Bryophytes, with the help of permanent slides and also by cutting sections.
5. Study of different Pteridophyta, with the help of permanent slides and also by cutting sections.

LAB COURSE III
CHEMISTRY (01CBZ1206)

Total Marks: 50 (35+15)

1. Inorganic Chemistry

Semi micro Analysis-cations analysis separation and identification of ions from Pb^{2+}, Bi^{3+}, Cu^{2+}, Cd^{2+}, Sb^{3+}, $Sn^{2+,4+}$, Fe^{3+}, AI^{3+}, Cr^{3+}. Ni^{2+}, $C0^{2+}$, Zn^{2+}, Mn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}, NH^{4+} and Anions $CO_2/^{3-}$, $SO_2/^{3-}$, S^{2-}, $SO_2/^{4-}$, NO_2^-, NO_3, CI^-,Br^-,I^-, CH_3COO^-, $C_2O_2/4^-$, $BO_3/^{5-}$, F^-.

2. Organic Chemistry

i. Calibration of Thermometer 80^0-82° (Naphthalene), 113.5^0-114^0 (Acetanilide), 132.5^0-133^0 (Urea), 1000(Distilled Water)

ii. Determination of Melting Point

80° -82° (Naphthalene), Benzoic and 121.5^0 -122°, Urea 132.5° -133°, Succinic acid 184.5^0-185^0, Cinnamic acid 132.5^0-133^0, Salicylic acid 157.5^0- 158^0 Acetanilide 113.5^0-114^0, m-Dinitrobenze 90^0, p-Dichlorobenzene 52^0 Aspirin 135^0.

iii. Determination of boiling points Ethanol = 78^0, Cyclohexane 81.4^0, To 110.6^0, Benzene 80^0

iv. Mixed meting point Determination- Urea- Cinnamic acid mixture of various compositions (1: 4, 1: 1, 4: 1)

SUGGESTIVE READINGS

1. Experimental Organic Chemistry, Vol. I & II, P.R. Singh, D.S. Gupta & K.S. bajpai, Tata Mc Graw Hill
2. Vogel's text book of practical organic chemistry, B.S. Furnis A.J. Hannaford, V. Rogers, P.W.G. Smith & Ar. Tatchel, ELBS
3. Experiments in general chemistry, CNR Rao & U.C. Agarwal
4. Experiments in physical chemistry, R. C. Das & B. Behara Tata Mc Graw Hill
5. Advanced practical physical chemistry, J.B. Yadav, Goel publishing house.

Yoga & Human Consciousness
Theory (01CBZ1103)

Learning Objectives:

- To increase the knowledge of the students about Yoga and to make students
- Aware about the holistic development through Yoga.
- To provide a practical knowledge on different yogic practices.
- To give a glimpse of ancient Yoga Philosophy.
- To impart some knowledge about the healing power of Yoga.
- To increase the professional efficiency in the field of Yoga

Learning Outcomes:

- Students gain good knowledge on the concept of yoga.
- Students know about the scientific benefits of various yogic practices
- Students can perform practical skills proficiently
- Students gain an awareness about the value of health & wellness through yoga
- Makes the students more enthusiastic about further study/research in the field of Yoga

Module I:

Introduction to Yoga:
i. Meaning and definitions of Yoga
ii. History of Yoga
iii. Importance of Yoga as art, science and philosophy
iv. Yogic Diet

Module II:

Philosophical Perspective of Yoga:
i. Yoga in Bhagavad Gita: Karma Yoga, Raja Yoga, Jnana Yoga and Bhakti Yoga
ii. The 'Yoga Sutras' in general; its significance in life.
iii. Limbs/parts of yoga (Astanga Yoga) according to the 'Yoga Sutras'
iv. Concept of Ishwara; Ishwara in Yoga Philosophy

Module III:

Yogic Practices for Health & Wellness:
i. Asana, its classification and effects
ii. Pranayama, its types and effects
iii. Kriya, Mudra and Bhandha: Procedure and Effects
iv. Yoga Vs Physical Exercise

Module IV:

Human Consciousness & Meditation
i. Meaning & Definition of Human Consciousness.
ii. Need for Study of Human Consciousness.
iii. Current Crisis of Human Consciousness & Measures for meaningful solution.
iv. The Theory of Meditation- Japa Meditation, Ajapajapa Meditation, Yoga Nindra, Tratak.

Practical
1 Credit (30 hours)

i. Suryanamskara – (12 counts)

ii. Asana

a) Standing: -Tadasana, Ardhakatichakrasana, Ardhachakrasana, Trikonasana, Vrikshasana.

b) Sitting: - Vajrasana, Padmasana, Goumukhasana, Paschimottanasana, Shashankasana.

c) Lying Supine Position: - Shavasana, Setubandhasana, Chakrasana, Sarvangasana, Halasana.

d) Lying Prone Position - Makarasana, Bhujangasana, Shalabhasana, Dhanurasana, Naukasana.

iii. Pranayama

Nadishodhana, Suryabhedana, Chandrabhedana, Shitali, Bhastrika, Bhramari.

iv. Bandh & Mudra: Jalandharabandha, Uddiyanbandha, Moolabandha, Yogamudra, Viparitkarnimudra, Shambhavimudra,

v. Dhyana and its forms