Maharaja Ranjit Singh
Punjab Technical University,
Bathinda-151001

SUPPLEMENTARY AGENDA

PART – II (Page 833-1205)

FOR THE

9TH MEETING OF ACADEMIC COUNCIL

TO BE HELD

ON

26.09.2023 (Tuesday) at

01:00 PM

IN

COMMITTEE ROOM, GZSCCET,

MRSPTU, Bathinda

Maharaja Ranjit Singh Punjab Technical University

Bathinda-151001

FACULTY OF SCIENCES

SYLLABUS

FOR

B.Sc. (FOOD SCIENCE AND TECHNOLOGY) /

BACHELOR OF FOOD SCIENCE AND TECHNOLOGY (Hons.)

2021 BATCH ONWARDS

(ii) Subject to change in the syllabi at any time.

Please visit the University website time to time.

SCHEME

Semester-I		Contact Hrs.			Marks			Credits
Subject code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-101	General Microbiology	3	1	-	40	60	100	4
BFOTS1-106	Introduction to Food Technology-I	3	1	-	40	60	100	4
BFOTS1-103	*Mathematics	3	1	-	40	60	100	4
BFOTS1-104	Computer Science and Applications	3	1	-	40	60	100	4
BFOTS1-105	General Microbiology Lab I	-	-	4	60	40	100	2
BPHAR0-002	**Life Sciences	3	1	-	40	60	100	4
BHUMA0-001	Communicative English	3	-	-	40	60	100	3
Total		**18**	**5**	**4**	**300**	**400**	**700**	**25**

*Mathematics for Medical Students
** Life Sciences for Non-Medical students.

Semester-II		Contact Hrs.			Marks			Credits
Subject code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-201	Introduction to Food Technology II	3	1	-	40	60	100	4
BFOTS1-202	Principles of Food Preservation	3	1	-	40	60	100	4
BFOTS1-203	Environmental Studies	3	-	-	40	60	100	3
BFOTS1-204	Food Chemistry	3	1	-	40	60	100	4
BFOTS1-205	Introduction to Food Technology II Lab-II	-	-	4	60	40	100	2
BFOTS1-206	Principles of Food Preservation Lab-III	-	-	4	60	40	100	2
Total		**12**	**3**	**8**	**280**	**320**	**600**	**19**

Semester-III		Contact Hrs.			Marks			Credits
Subject code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-301	Dairy Technology	3	1	-	40	60	100	4
BFOTS1-302	Technology of Fruits & Vegetables	3	1	-	40	60	100	4
BFOTS1-303	Food Microbiology and Food Safety	3	1	-	40	60	100	4
BFOTS1-304	Dairy Technology Lab IV	-	-	4	60	40	100	2
BFOTS1-305	Technology of Fruits & Vegetables Lab V	-	-	4	60	40	100	2
BFOTS1-306	Food Microbiology and Food Safety Lab VI	-	-	4	60	40	100	2
Departmental Elective -I (Select any one)								
BFOTD1-311	Entrepreneurship Development	3	-	-	40	60	100	3
BFOTD1-312	Food Fermentation Technology							
BFOTD1-313	Food Additives							
BMNCC0-004	Drug Abuse	2	-	-	100	-	100	0
Total		**14**	**3**	**12**	**440**	**360**	**800**	**21**

Semester-IV		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-401	Technology of Cereals, Pulses and Oilseeds	3	1	-	40	60	100	4
BFOTS1-402	Egg, Poultry & Meat Technology	3	1	-	40	60	100	4
BFOTS1-403	Food Plant Hygiene and Sanitation	3	1	-	40	60	100	4
BFOTS1-404	Technology of Cereals, Pulses and Oil Seeds Lab VII	-	-	4	60	40	100	2
BFOTS1-405	Egg, Poultry & Meat Technology Lab VIII	-	-	4	60	40	100	2
BFOTS1-406	Food Plant Hygiene and Sanitation Lab IX	-	-	4	60	40	100	2

Departmental Elective-II								
BFOTD1-411	Nutraceutical and Functional Foods	4	-	-	40	60	100	4
BFOTD1-412	Nutraceutical and Functional Foods Lab X	-	-	4	60	40	100	2
OR								
BFOTD1-413	Bakery Technology	4	-	-	40	60	100	4
BFOTD1-414	Bakery Technology Lab XI	-	-	4	60	40	100	2
Total		**13**	**3**	**16**	**400**	**400**	**800**	**24**

Note: All the students are required to undergo 'In Plant Training' for 4 weeks in a Food Processing unit after final examinations of 4th semester. Final degree to the students will be awarded subject to their successfully completion of 'In Plant Training' as per university norms.

Semester-V		**Contact Hrs.**			**Marks**			**Credits**
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-501	Unit Operations in Food Engineering	3	1	-	40	60	100	4
BFOTS1-502	Food Packaging	3	1	-	40	60	100	4
BFOTS1-503	Sugar & Confectionary Technology	4	-	-	40	60	100	4
BFOTS1-504	Food Packaging Lab XII	-	-	4	60	40	100	2
BFOTS1-505	Sugar & Confectionary Technology Lab XIII	-	-	4	60	40	100	2
Departmental Elective-III								
BFOTD1-511	Spices and Flavour Technology	4	-	-	40	60	100	4
BFOTD1-512	Spices and Flavour Technology Lab XIV	-	-	4	60	40	100	2
OR								
BFOTD1-513	Technology of Oils and Fats	4	-	-	40	60	100	4
BFOTD1-514	Technology of Oils and Fats Lab XV	-	-	4	60	40	100	2
TOTAL		**14**	**2**	**12**	**340**	**360**	**700**	**22**

Note: In Semester-V students have to choose either between:
BFOTD1-511, BFOTD1-512 or BFOTD1-513, BFOTD1-514

Semester-VI		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-601	Food Engineering	3	1	-	40	60	100	4
BFOTS1-602	Food and Nutrition	3	1	-	40	60	100	4
Departmental Elective-IV								
BFOTD1-611	Sensory Evaluation of Food	4	-	-	40	60	100	4
BFOTD1-612	Sensory Evaluation of Food Lab XVI	-	-	4	60	40	100	2
OR								
BFOTD1-613	Food Plant Layout	4	-	-	40	60	100	4
BFOTD1-614	Food Plant Layout Lab XVII	-	-	4	60	40	100	2
Departmental Elective-V								
BFOTD1-621	Food Safety	4	-	-	40	60	100	4
BFOTD1-622	Food Safety Lab XVIII	-	-	4	60	40	100	2
OR								
BFOTD1-623	Food Quality Management	4	-	-	40	60	100	4
BFOTD1-624	Food Quality Management Lab XIX	-	-	4	60	40	100	2
TOTAL		**14**	**2**	**8**	**280**	**320**	**600**	**20**

Note: In Semester-VI students have to choose between:
BFOTD1-611, BFOTD1-612 or BFOTD1-613, BFOTD1-614
BFOTD1-621, BFOTD1-622 or BFOTD1-623, BFOTD1-624

Semester-VII		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
BFOTS1-701	Food Storage Engineering	4	-	-	40	60	100	4
BFOTS1-702	Food Biotechnology	4	-	-	40	60	100	4
BFOTS1-703	Technology of Beverages	4	-	-	40	60	100	4
BFOTS1-704	Snacks and Extrusion Technology	4	-	0	40	60	100	4
BFOTS1-705	Technology of Beverages Lab XX	-	-	4	60	40	100	2
BFOTS1-706	Snacks and Extrusion Technology Lab XXI	-	-	4	60	40	100	2
TOTAL		**16**	**-**	**8**	**280**	**320**	**600**	**20**

Semester-VIII			Contact Hrs.			Marks			Credits
Subject Code	Subject name		L	T	P	Int.	Ext.	Total	
BFOTS1-801	PROJECT WORK	*Monthly Progress Report	-	-	-	100	-	100	4
		Seminar	-	-	-	100	100	200	8
		Viva-voice	-	-	-	100	100	200	8
TOTAL			-	-	-	**300**	**200**	**500**	**20**

Overall Marks / Credits:

Semester	Marks	Credits
I	700	25
II	600	19
III	800	21
IV	800	24
V	700	22
VI	600	20
VII	600	20
VIII	500	20
Total	**5300**	**171**

SEMESTER FIRST

GENERAL MICROBIOLOGY

Subject Code: BFOTS1-101 **L T P C** **Duration: 60Hrs.**
3 1 0 4

Course Objectives:
1. To understand theories related to growth of micro-organisms and their disease causing abilities.
2. To memorize the general characteristics of micro-organisms in relation to their effect on plant and human health.
3. To identify suitable tools, equipments and environmental conditions for the growth of micro-organisms.
4. To analyze the appropriate techniques for the control of microbial spoilage in foods.
5. To evaluate the various environmental factors affecting microbial growth.

Course Outcomes:
1. Understanding the various theories related to growth of micro-organisms and their disease causing abilities
2. Remembering the general characteristics of micro-organisms in relation to their effect on plant and human health.
3. Selection of suitable tools, equipments and environmental conditions for the growth of micro-organisms.
4. Identifying the appropriate method for the control of micro-organisms that result in food preservation.
5. Evaluation of various environmental factors affecting microbial growth.

UNIT-I (15Hrs.)

Introduction: Discovery of microbial world, theory of spontaneous generation, Germ theory of disease, Koch's postulates, Pure culture concept, Nature and properties of prokaryotic and eukaryotic micro-organisms.

UNIT-II (15Hrs.)

General characteristics and Nutritional requirements: General characteristics of bacteria, yeast, mold, viruses, algae. Types of bacteria, nutritional classification of bacteria.
Reproduction of micro-organisms: Brief account of bacteria, yeast and mold reproduction.

UNIT-III (15Hrs.)

Microbial Growth: Definition of growth, growth cycle, growth rate, generation time, measurement of growth, effect of environmental factors such as temperature, oxygen, moisture, salt, pH, oxidation-reduction potential and radiations on growth.

UNIT-IV (15Hrs.)

Cultivation of micro-organisms: Pour plate method, spread plate method and streak plate Control of Micro-organisms: Control of micro-organisms by physical, chemical and biological methods.

Recommended Books:
1. Pelczar M. J., Chan E.C.S. and Krieg N.R., 'Microbiology', 5th Edition., McGraw Hill Co, Singapore,1987.
2. Stanier R.Y., Graham J.L., Wheelies M.L. and Painter P.R., 'General Microbiology', 5thEdition., The Macmillan Press Ltd.,London,1993.
3. Cappuccino J.G. and Sherman N., 'Microbiology: A Laboratory Manual', Benjamine- Cummings Publishing Co., USA,2004.
4. Gunase K. P., 'Laboratory Manual in Microbiology', New Age International (P) Ltd. New Delhi,1996

INTRODUCTION TO FOOD TECHNOLOGY-I

Subject code: BFOTS1-106 **L T P C** **Duration: 60Hrs.**
3 1 0 4

Course Objectives:

1. To impart knowledge regarding various disciplines of food science and technology and their applications in food production and preservation.
2. To understand the selection of appropriate techniques for the production of nutrient dense foods2.
3. To acquire knowledge about compositional and nutritional properties of different cereal grains that aid in the production of different food products.
4. To summarize degradation of fats and oils and its prevention.
5. To analyze the effects of various physico-chemical changes occur during processing of foods.

Course Outcomes:

1. Creating awareness about various disciplines of food science and technology and their applications in food production and preservation.
2. Understanding about selection of appropriate techniques for the production of nutrient dense foods.
3. Acquire knowledge about compositional and nutritional properties of different cereal grains that aids in the production of different food products.
4. Identifying problems related to the degradation of fats and their solutions that results in preservation.
5. Imparting knowledge about various physical and chemical changes occur during processing.

UNIT-I (11Hrs.)

Introduction to Food Science and Technology, its scope and importance.

UNIT-II (18Hrs.)

Compositional, Nutritional and Technological aspects of Plant foods
Wheat: structure and composition, types (hard, soft/strong, weak) Diagrammatic representation of structure of wheat grain.
Rice: Structure and composition, parboiling of rice- advantages and disadvantages. Malting, gelatinization of starch, types of browning- Maillard & caramelization.
Corn: Structure and composition, Dry and wet milling.
Millets: Types of millets and its nutritional properties.

UNIT-III (15Hrs.)

Pulses: Structure and composition of pulses, toxic constituents in pulses, processing of pulses: soaking, germination, decortication, cooking and fermentation.

UNIT-IV (16Hrs.)

Fats and Oils: Classification of lipids, types of fatty acids - saturated fatty acids, unsaturated fatty acids, essential fatty acids, trans fatty acids. Rancidity –Types- hydrolytic and oxidative rancidity and its prevention.

Recommended Books

1. Manay, S. and Shadaksharaswami, M., 'Foods: Facts and Principles', New Age Publishers, 2004.
2. Srilakshmi B., 'Food science', New Age Publishers,2002.
3. Meyer L. H., 'Food Chemistry', New Age,2004
4. Kenneth F. et al, edited-Vol-1, 2, 'The Cambridge World History of Food, Cambridge', Univ. Press,2000.
5. Eastwood M., 'Principles of Human Nutrition', 2nd Edition, Blackwell Publishing,2003.

MATHEMATICS

Subject Code: BFOTS1-103 **L T PC 3 1 0 4** **Duration: 60Hrs.**

Course Objectives:
1. To impart knowledge about basics of algebra and geometry.
2. To understand the numerical part and its application in solving problems related to processing and preservation.
3. To summarize the link between mathematics and Food Science.
4. To select appropriate techniques and methodologies for application in food engineering.
5. To develop an ability of cost analysis involved during construction and designing of food processing plants.

Course Outcomes:
1. Imparting knowledge about basics of algebra and geometry.
2. Understanding the numericals and their application in solving problems related to processing and preservation.
3. Summarizing the link between mathematics and Food Science.
4. Selection of appropriate techniques and methodologies for application in food engineering.
5. Developing an ability of cost analysis involved during construction and designing of food processing plants.

UNIT-I (17Hrs.)

Mensuration: Mensuration of rectangles, easy examples of garden paths, cost of planting trees and fencing gardens. Area of right angled triangles area and height of isosceles and equilateral triangles, area of triangles in terms of sides, rent of field. Area of parallelograms, rhombus, quadrilateral and trapezoid. Regular polygons with emphasis on hexagon and octagon. Simple cases of similar figures. Circumference and area of circles. Circular rings. Cost of fencing circular fields and paths.

UNIT-II (14Hrs.)

Mensuration: Volumes of cubes and rectangular solids. Cubic contents of tanks and cisterns, Volumes of triangular & rectangular prisms, right circular cylinders and segments of cylinders (Easy numerical examples based on Science only to be set Proofs of formulae).

UNIT-III (15Hrs.)

Algebra: Solution of quadratic equations and of those reducible to quadratic equation (One variable). Relation between roots and co-efficients.nth term and sum to n terms of an A. P. and
G.P. nth term of an H. P.(excluding means and problems on numbers). Permutation and combinations: simple problems only. (Proofs of formulae not required).

UNIT-IV (14Hrs.)

Matrix and Determinant: Introduction matrices, Types of matrices, Operation of matrices, Transpose of matrix, Matrix multiplication, Determinants, Properties of determinants, Products of determinants, Minors and co-factors, Adjoint of a square matrix, Singular and non singular matrices, Inverse of Matrices.

Recommended Books
1. Algebra by Kapoor D. C. and SinghG.
2. Algebra by Nagpal T. N. and GuptaK.K.
3. Comprehensive Calculus by Dehiya R.S.
4. New Style Calculus for T. D.C

COMPUTER SCIENCE & APPLICATIONS

Subject Code: BFOTS1-104 **L T PC 3 1 0 4** **Duration: 60Hrs.**

Course Objectives:

1. To understand the basics of computers and terminologies used.
2. To identify problems related to security against computer viruses along with their preventive measures.
3. To provide knowledge about collection, storage and analysis of data with least human errors.
4. To create an ability to prepare effective presentations and communicate with target audience.
5. To develop managerial skills by imparting knowledge about applications of computers in different fields.

Course Outcomes:

1. Understanding the basics of computers and terminologies used.
2. Identifying the problems related to security against computer viruses along with their preventive measures.
3. Providing knowledge about collection, storage and analysis of data with least human errors.
4. Creating an ability to prepare effective presentations and communicating with target audience.
5. Developing managerial skills by imparting knowledge about applications of computers in different fields.

UNIT-I (16Hrs.)

Computer Fundamentals Introduction to Computers: Characteristics of computers, Historical perspectives of computers, Computer generations, types of computers and uses, Software, Hardware, Basic architecture and functions of CPU and its parts, Important I/O devices like Keyboard, Mouse, Printers, Video Monitors. Memory Storage: Memory Cells, Semiconductor and Magnetic core memory, ROM (its types), RAM, Cache and Virtual memory, Secondary storage devices and their organization (Hard disk, Floppy disk, CD, DVD).

UNIT-II (16Hrs.)

Operating Systems: Definitions, Need, Organization, Functions, Types of Operating Systems, DOS, Windows, Handling Drives, Directories and files, Commands (Internal & External), Icons, Clipboard, Folders, Major differences between DOS & Windows.
Communication Networks: Hardware and software components, seven layers of OSI architecture, Network Topologies (Ring, Star, Fully Connected and Bus), LAN and WAN, Bounded and unbounded communication media, Internet, World Wide Web and I.T., Browsers, Important terminology regarding Internet applications.

UNIT-III (14Hrs.)

Computer Applications Word Processing: Techniques, File manipulation, Formatting, Printing setups Table handling, Mail merge, etc. using MS-Word.
Spreadsheet Package: Worksheets, formatting sheets, Calculations and graphing using formulae and functions, Import and export of data using MS-Excel.

UNIT- IV (14Hrs.)

Computer Applications Graphics: Objectives and types of graphics, Presentation packages, Slides designing, Diagrams and graphs, Import & Export data using MS-Power Point.

Data Security against Viruses: Definition of computer viruses, detection, prevention and cure against viruses using anti-virus software packages.

Recommended. Books

1. Rajaraman, 'Fundamentals of Computers', Prentice Hall ofIndia.
2. N.K. Tiwari, 'Computer Fundamental with Pharmacy Applications', 1st Edition, Pharm. MedPress,2008.
3. Stultz, 'Learn MS-Office 2000', BPBPublications.
4. Ivens, 'Using Microsoft Windows', Prentice Hall of India,1998.
5. Stultz, 'Learn DOS in a day', BPBPublication

GENERAL MICROBIOLOGY LAB-I

Subject Code: BFOTS1-105 **L T P C** **Duration: 60Hrs.**
0 0 4 2

Course Objectives:

1. To understand working of different equipments used in microbiology and their applications in food production and preservation.
2. To impart knowledge about practical handling of microbiological tools.
3. To determine the microbial load of different food products with suitable techniques and interpret the factors associated with them.
4. To identify the methods for cultivation, isolation and storage of micro-organisms that can be beneficial for human health and environment.
5. To develop an ability to work effectively both individually and as a team member during the collection of samples from different sources.

Course Outcomes:

1. Understanding about working of different equipment's of microbiology and their applications in food production and preservation.
2. Imparting knowledge about practical handling of microbiological tools that ensures safety of food products.
3. Determination of microbial load of different food products with suitable techniques and interpret the factors associated with them.
4. Identification of suitable methods for the cultivation, isolation and storage of micro-organisms that can be beneficial for human health and environment.
5. Creating ability to work effectively both individually and as a team during the collection of samples from different sources.

Practical

1. To study different parts of amicroscope.
2. Study of instruments (Autoclave, Hot air oven, Incubator, Laminar flow, pH meter, and spectrophotometer) of microbiology laboratory.
3. Preparation of nutrient agar and Mac Conkey's Agar plates, slants and broth.
4. To study the serial dilution method.
5. To perform pour plate, spread plate and streak plate methods for isolation and enumeration of micro-organisms.
6. To perform Simple staining.
7. To stain the given bacteria by Gram's staining method.
8. To perform negative staining.
9. To determine the number of micro-organisms with a Haemocytometer.
10. To determine the motility of bacteria by hanging drop method.

LIFE SCIENCES

Subject code: BPHAR0-002 **L T PC 3 1 0 4** **Duration: 60 Hrs.**

Course Objectives

1. To understand the basics of cell and molecular biology.
2. To impart knowledge regarding physiology and anatomy of human body.
3. To identify the micro-organisms responsible for infectious and contagious diseases along with their preventive measures.
4. To create an ability to develop vaccines and antibiotics for societal benefits.
5. To apply basics of genetic engineering in food and human health that can support agro-food industries.

Course outcome:

1. Understanding the basics of cell and molecular biology.
2. Imparting knowledge regarding physiology and anatomy of human body.
3. Identification of micro-organisms responsible for infectious and contagious diseases along with their preventive measures.
4. Creating an ability to develop vaccines and antibiotics for societal benefits.
5. Application of basics of genetic engineering in food and human health that can support agro-food industries.

UNIT-I (15Hrs.)

Cell & Molecular Biology: Cell theory, Prokaryotic cell, eukaryotic cell, cell wall, cell membrane, cytoskeleton, nucleus, chloroplast, mitochondria, endoplasmic reticulum, golgi bodies, ribosomes, lysosomes, vacuoles and centrosomes.

UNIT- II (15Hrs.)

Cell cycle & division, amitosis, mitosis and meiosis. Study of genetic material, structure of DNA and RNA, replication, transcription, genetic code, translation & DNA repair.
Human physiology: Digestion and absorption, breathing and respiration, circulation, excretory system, nervous system, skeletal and muscular systems.

UNIT-III (12Hrs.)

Human health and diseases: Pathogens, Parasites causing human disease (malaria, dengue, chickenguinea, typhoid, pneumonia, common cold, ringworm) and their control. Basic concepts of immunology, vaccines, antibiotics, cancer, HIV and AIDS.

UNIT-IV (18Hrs.)

Biotechnology and its applications: Recombinant DNA technology, applications in health, agriculture and industries, genetically modified organisms; Plant breeding, tissue culture, single cell protein, Transgenic plants and transgenic animals.

Recommended books:

1. Lehninger A. L., David L. N. and Michael M. C., ‘Principles of Biochemistry’, Worth Publishers, 1993.
2. Singh B.D., ‘Biotechnology’, KalyaniPublishers.
3. Harvey L., Arnold B., Chris A. K., Paul M., Monty K., Jems D. and Mathew P. S., ‘Molecular Cell Biology’, W.H. Freeman,2004.

COMMUNICATIVE ENGLISH

Subject Code: BHUMA0-001	L T P C 3 0 0 3	Duration: 45 Hrs.

Course Objectives:

1. To understand the concept of effective communication, its components, and importance for life-long learning.
2. To impart knowledge regarding different communication styles and their matrix.
3. To engage students in team work by organizing group discussions on different topics.
4. To improve interview skills of students and applying those to crack future interviews.
5. To develop the art of being an effective presenter using specific presentation and communication skills.

Course Outcomes:

1. Understanding the concept of effective communication, its components, and importance for life-long learning.
2. Imparting knowledge regarding different communication styles and their matrix.
3. Engaging students in team work by organizing group discussions on different topics.
4. Improving interview skills of students and applying those to crack future interviews.
5. Developing the art of being an effective presenter using specific presentation and communication skills.

UNIT-I (12 Hrs.)

Communication Skills: Introduction, Definition, the Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context.
Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers.

UNIT-II (11Hrs.)

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment.
Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

UNIT-III (12Hrs.)

Communication Styles: Introduction, The Communication Styles Matrix with example for each Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.
Basic Listening Skills: Introduction, Self-Awareness, Active Listening, becoming an Active Listener, Listening in Difficult Situations.

UNIT-IV (10Hrs.)

Interview Skills: Purpose of an interview, Do's and Don'ts of an interview
Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion.

Recommended Books

1. Ruther Ford A. J., 'Basic Communication Skills for Technology', 2nd Edition, Pearson Education,2011.
2. Kumar S. and Pushplata, 'Communication Skills', 1st Edition, Oxford Press,2011.
3. Stephen P. Robbins, 'Organizational Behaviour', 1st Edition, Pearson,2013.
4. Gill H., 'Brilliant-Communication Skills', 1st Edition, Pearson Life,2011.
5. Gopalawamy R., 'The Ace of Soft Skills: Attitude, Communication and Etiquettefor Success', 5th Edition, Pearson,2013.
6. Dalley D., Burton L. and Margaret G., 'Developing your Influencing Skills', Green Hall, 1st Edition, Universe of Learning LTD,2010.
7. Konarnira, 'Communication Skills for Professionals', 2nd Edition, PHI,2011.
8. Mitra B. K., 'Personality Development and Soft Skills', 1st Edition, Oxford Press,2011.
9. 'Soft Skill for Everyone', Butter Field, 1stEdition, Cengage Learning India Pvt. Ltd., 2011.
10. Francis Peters S.J., 'Soft Skills and Professional Communication', 1st Edition, McGraw HillEducation, 2011.
11. John A., 'Effective Communication', 4th Edition, Pan MacMillan, 2009.
12. Aubrey D., 'Bringing out the Best in People', 2nd Edition, McGraw Hill,1999.

SEMESTER SECOND

INTRODUCTION TO FOOD TECHNOLOGY–II

Subject Code: BFOTS1-201 **L T P C** **Duration: 60Hrs.**
3 1 0 4

Course Objectives:

1. To understand the physiological-, physical-, chemical-, and pathological changes during storage of fruits and vegetables.
2. To impart knowledge regarding compositional and nutritional aspects of fruits and vegetables, useful in the development of value-added products.
3. To apply ethics during the handling, processing and preservation of animal products.
4. To summarize the general processing methods of Indian spices and their therapeutic uses.
5. To identify appropriate techniques for the quality evaluation of plant and animal based food products.

Course Outcomes:

1. Understanding the physiological-, physical-, chemical-, and pathological changes during storage of fruits and vegetables.
2. Imparting knowledge regarding compositional and nutritional aspects of fruits and vegetables, useful in the development of value-added products.
3. Applying ethics during the handling, processing and preservation of animal products.
4. Summarizing the general processing methods of Indian spices and their therapeutic uses.
5. Identification of appropriate techniques for the quality evaluation of plant and animal based food products.

UNIT-I (16Hrs.)

Fruits and Vegetables: Classification of fruits and vegetables, general composition, enzymatic browning, names and sources of pigments, Dietary fibre.
Postharvest changes in fruits and vegetables: Climacteric rise, horticultural maturity, physiological maturity, physiological changes, physical changes, chemical changes, pathological changes during the storage of fruits and vegetables.

UNIT-II (17Hrs.)

Compositional, Nutritional and Technological aspects of Animal foods Flesh Foods - Meat, Fish, Poultry
Meat- Definition of carcass, concept of red meat and white meat, composition of meat, marbling, post-mortem changes in meat- rigor mortis, tenderization of meat, ageing of meat.

Fish- Classification of fish (fresh water and marine), aquaculture, composition of fish, characteristics of fresh fish, spoilage of fish- microbiological, physiological, biochemical.

Poultry- Structure of hen's egg, composition and nutritive value, egg proteins, characteristics of fresh egg, deterioration of egg quality, difference between broiler and layers.

UNIT-III (12Hrs.)

Milk and Milk Products: Definition of milk, chemical composition of milk, its constituents, processing of milk, pasteurization, homogenization. An overview of types of market milk & milk products.

UNIT-IV (15Hrs.)

Food Spices and Condiments: Types and uses of spices and condiments, Chemical composition, Extraction, General processing, uses and special attributes of important Indian spices like pepper, cinnamon, clove, ginger, turmeric, cardamom, fenugreek and fennel, seasonings and condiments blend.

Recommended Books

1. ManayS.andShadaksharaswamiM.,'Foods:FactsandPrinciples',NewAgePublishers,
2. 2004.
3. Srilakshmi B., 'Food Science', New Age Publishers,2002.
4. Meyer L. H., 'Food Chemistry', New Age,2004
5. Kenneth F. et.al, edited-Vol-1, 2, ' The Cambridge World History of Food', Cambridge Univ.Press, 2000.
6. Eastwood M., 'Principles of Human Nutrition', 2nd Edition Blackwell publishing,2003.

PRINCIPLES OF FOOD PRESERVATION

Subject Code: BFOTS1-202 **L T P C 3 1 0 4** **Duration: 60Hrs**

Course Objectives:

1. To impart knowledge regarding various methods of preservation of food and their effect on physiochemical properties of food.
2. To identify appropriate equipments for preservation of different food products aiming at minimal degradation of nutrients.
3. To understand the problems associated with food spoilage and selection of suitable methods of their preservation.
4. To analyze and interpret freezing and drying curves of different food products.
5. To create awareness regarding the effect of chemical and physical preservation techniques on health and nutritional components of food.

Course Outcomes:

1. Imparting knowledge regarding various methods of preservation of food and their effect on physiochemical properties of food.
2. Identification of appropriate equipments for preservation of different food products aiming at minimal degradation of nutrients.
3. Understanding the problems associated with food spoilage and selection of suitable methods of their preservation.
4. Analyzing and interpreting freezing and drying curves of different food products.
5. Creating awareness regarding the effect of chemical and physical preservation techniques on health and nutritional components of food.

UNIT-I (11Hrs.)

Introduction: Historical developments of food preservation. Principles of Food preservation, Scope & its benefits. Chemical preservation: Class I and Class II preservatives.

UNIT-II (16Hrs.)

Preservation by low temperature: Introduction, Freezing and Refrigeration, cold storage and freezing, freezing curve, changes during freezing, types of freezing; slow freezing, quick freezing, thawing, changes during thawing and its effects on food.

UNIT-III (16Hrs.)

Preservation by high temperature: Thermal processing, Sterilization, commercial sterilization, pasteurization, and blanching. boiling, canning, aseptic processing, thermal death time.

UNIT-IV (17Hrs.)

Preservation by Drying: Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), factors affecting rate of drying, normal drying curve, Various types of driers used in food industry.

Irradiation: Units of radiation, Ultraviolet and ionizing irradiations, their effect on microorganisms & uses in food processing.

Recommended Books

1. Desrosier N. W. and Desrosier J. N., 'The Technology of Food Preservation', CBS Publication, New Delhi,1998.
2. Paine F.A. and Paine H.Y., 'Handbook of Food Packaging', Thomson Press India Pvt Ltd, New Delhi,1992.
3. Potter N.H., 'Food Science', CBS Publication, New Delhi,1998.
4. RamaswamyHandMarcottM.,'FoodProcessingPrinciplesandApplications',CRCPress,
5. 2006.
6. Rao P.G., 'Fundamentals of Food Engineering', PHI Learning Pvt Ltd, New Delhi,2010.
7. Toledo R. T, 'Fundamentals of Food Process Engineering', Aspen Publishers,1999.

ENVIRONMENTAL STUDIES

Subject Code: BFOTS1-203 **L T P C** **Duration: 45Hrs.**
3 0 0 3

Course Objectives:

1. To understand the concept of renewable and non-renewable resources of environment.
2. To identify the problems associated with different environmental resources.
3. To impart knowledge regarding different types of ecosystems and their characteristic features.
4. To analyze the causes of water, soil and air pollution and implementing some effective measures to save them for societal benefits.
5. To create awareness regarding role of an individual in conservation of natural resources and communicating it to society.

Course Outcomes:

1. Understanding the concept of renewable and non-renewable resources of environment.
2. Identifying the problems associated with different environmental resources.
3. Imparting knowledge regarding different types of ecosystems and their characteristic features.
4. Analyzing the causes of water, soil and air pollution and implementing some effective measures to save them for societal benefits.
5. Creating awareness regarding role of an individual in conservation of natural resources and communicating it to society.

UNIT-I (11Hrs.)

The multidisciplinary nature of environmental studies, Natural Resources, Renewable and non- renewable resources: Natural resources and associated problems.

UNIT-II (12Hrs.)

Forest Resources, Water Resources, Mineral Resources, Food resources, Energy resources, Land resources, Role of an individual in conservation of naturalresources.

UNIT-III (12Hrs.)

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Introduction,
types, characteristic features, Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- IV (10Hrs.)

Environmental Pollution: Air pollution; Water pollution; Soil pollution.

Recommended Books

1. Sing Y.K., ‘Environmental Science’, New Age International Pvt, Publishers,Bangalore.
2. Agarwal K.C., ‘Environmental Biology’, Nidi Publ. Ltd. Bikaner,2001.
3. Erach B., ‘The Biodiversity of India,’ Mapin Publishing Pvt.Ltd.
4. Brunner R.C., ‘Hazardous Waste Incineration’, McGraw HillInc.
5. Clark R.S., ‘Marine Pollution’, Clanderson PressOxford.
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. ‘Environmental Encyclopedia’,Jaico Publ. House, Mumbai, 1196p,2001.
7. De A.K., ‘Environmental Chemistry’, Wiley EasternLtd.
8. Down of Earth, Centre for Science and Environment.https://www.downtoearth.org.in/

FOOD CHEMISTRY

Subject Code: BFOTS1-204 **L T P C** **Duration: 60Hrs.**
3 1 0 4

Course Objectives:

1. To understand the compositional aspects of different categories of foods.
2. To impart knowledge regarding role of water activity in extending the shelf life of food products and selection of appropriate packaging material.
3. To summarize various deteriorative changes of fats and oils.
4. To analyze physico-chemical-, and functional properties of proteins and carbohydrates and development of various food products.
5. To create awareness regarding different types of food flavors and importance of water- and fat soluble vitamins.

Course Outcomes:

1. Understanding the compositional aspects of different categories of foods.
2. Imparting knowledge regarding role of water activity in extending the shelf life of food products and selection of appropriate packaging material.
3. Summarizing various deteriorative changes of fats and oils.
4. Analyzing physico-chemical-, and functional properties of proteins and carbohydrates and development of various food products.
5. Creating awareness regarding different types of food flavors and importance of water- and fat soluble vitamins.

UNIT-I (12Hrs.)

Introduction to Food: Definition and Composition.
Water: Structure of water and ice, Types of water, Sorption phenomenon, Water activity and packaging.

UNIT-II (16Hrs.)

Lipids: Classification, Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. Chemical properties- reichertmeissel value, polenske value, iodine value, peroxide value, saponificationvalue.
Changes in fats and oils: rancidity, lipolysis, flavor reversion, Fat Mimetics.

UNIT-III (17Hrs.)

Proteins: Protein classification and structure, Nature of food proteins (plant and animal proteins). Properties of proteins (electrophoresis, sedimentation, amphoterism and denaturation),
Functional properties of proteins, organoleptic, solubility, viscosity, binding gelation/ texturization, emulsification, foaming.
Carbohydrates: Classification and Functions (monosaccharides, oligosaccharides and polysaccharides), Modified celluloses and starches.

UNIT-IV (15Hrs.)

Vitamin: Importance and Stability, Water soluble &Fat soluble vitamins.
Flavour: Definition and basic tastes, Description of food flavours, Flavour enhancers.

Recommended Books

1. Fennema O. R, 'Food Chemistry', 3rd Edition, Marcell Dekker, NewYork,1996.
2. Whitehurst R. J. and Law B. A., 'Enzymes in Food Technology', CRC Press,Canada,2002.
3. Wong Dominic W. S., 'Food Enzyme, Chapman and Hall, New York,1995.
4. Potter N.N. and Hotchkiss J. H, Food Science', 5thEdition., Chapman &Hall,1995.
5. DeMan J.M., 'Principles of Food Chemistry', AVI, NewYork,1980.

INTRODUCTION TO FOOD TECHNOLOGY-II LAB II

Subject Code: BFOTS1-205 **L T P C** **Duration: 60Hrs.**
0 0 4 2

Course Objectives

1. To impart knowledge regarding basic instruments used in the food industries for analysis of food components.
2. To familiarize the students with methodologies used for determination of various quality attributes, adhering to legal specifications.
3. To conduct qualitative tests for major food components.
4. To determine chemical components of food products quantitatively.
5. To analyze and interpret data for various quality attributes and using this information for product improvement.

Course Outcomes:

1. Imparting knowledge regarding basic instruments used in the food industries for analysis of food components.
2. Familiarizing the students with methodologies used for determination of various quality attributes, adhering to legal specifications.
3. Conducting qualitative tests for major food components.
4. Determination of chemical components of food products quantitatively.
5. Analysis and interpretation of data for various quality attributes and using this information for product improvement.

PRACTICALS

1. Demonstration of the instruments used in food technology.
2. Determination of moisture content in different food samples.
3. Determination of ash content of different food samples.
4. Determination of TSS of ketchup by refractometer.
5. Determination of acidity of milk and juices.
6. To study the effect of blanching on vegetables.
7. Determination of specific gravity of oil and milk.
8. Determination of pH of food samples by pH meter.
9. Determination of saponification value and acid value.
10. Qualitative test for starch and protein.

PRINCIPLES OF FOOD PRESERVATION LAB III

Subject Code: BFOTS1-206 **LT P C** **Duration: 60Hrs**
0 0 4 2

Course Objectives:

1. To prepare value added products from fruits and vegetables.
2. To understand the effects of hydrothermal processes on different vegetables.
3. To analyze quality attributes of packaged food products.
4. To apply different food preservation techniques for preservation of food products.
5. To gain practical knowledge of various instruments used in food processing industries.

Course Outcomes:

1. Preparation of value added products from fruits and vegetables.
2. Understand the effects of hydrothermal processes on different vegetables.
3. Analysis of quality attributes of packaged food products.
4. Application of different food preservation techniques for preservation of food products.
5. Gaining practical knowledge of various instruments used in food processing industries.

Practical's

1. Cut out analysis of canned foods.
2. Preservation of fruits and vegetables by syruping and salting.
3. Preservation by paraffining.
4. Preparation of sauerkraut.
5. To determine the adequacy of blanching on vegetables.
6. To enhance the shelf life of eggs by oiling and pickling.
7. To study the curing of meat.
8. Preservative effect of honey and different concentrations.
9. Preservation of fruits and vegetables by salt, oil and vinegar.
10. Visit to food industry

SEMESTER THIRD

DAIRY TECHNOLOGY

Subject Code: BFOTS1-301 **L T P C** **Duration: 60 (Hrs.)**
3 1 0 4

Course Objectives:

1. To understand physico-chemical properties, microbiology, and nutritive value of milk.
2. To impart knowledge regarding various steps involved in the production of market milk as per specified legal standards.
3. To summarize process of manufacturing of cream, ghee, butter, milk powders, ice cream, and cheese and identify associated defects.
4. To develop fermented milk and other indigenous milk products.
5. To create awareness regarding selection of equipment's for the processing and quality assessment of milk and milk products.

Course Outcomes:

1. Understanding the physico-chemical properties, microbiology, and nutritive value of milk.
2. Imparting knowledge regarding various steps involved in the production of market milk as per specified legal standards.
3. Summarizing the process of manufacturing of cream, ghee, butter, milk powders, ice cream, and cheese and identifying the associated defects.
4. Development of fermented milk and other indigenous milk products.
5. Creating awareness regarding selection of equipment's for the processing and quality assessment of milk and milk products.

UNIT-I (15 Hours)

Definition of milk, Market milk, Composition, Physicochemical properties and nutritive value of milk, microbiology of milk, Factors affecting composition of milk.

UNIT-II (15 Hours)

Liquid milk processing: Collection of milk, Reception, Platform testing.
Various stages of processing: Filtration, Clarification, Homogenization and Pasteurization.
Description and working of clarifier, cream separator, homogenizer and plate heat exchanger.

UNIT-III 15 Hours)

Cream: Types, manufacturing and defects.
Butter: Types, preparation, theories of churning, defects.
Preparation and defects of Ghee, flavored milk, condensed milk and milk powder.

UNIT-IV (15 Hours)

Manufacturing and defects of Ice-cream and cheese.
Fermented milk and milk products: Yoghurt, dahi and shrikhand.
Indigenous milk products.

Recommended Text Books / Reference Books:

1. De Sukumar, Outlines of Dairy Technology, Oxford University Press, Oxford, UK, 2007.
2. Webb and Johnson, Fundamentals of Dairy Chemistry, 3rd ed., CBS Publishers, New Delhi, 1988.
3. Eckles, Combs, Henery C, and Willes C, Milk & Milk Products, Tata McGraw Hill Publishers, USA, 1997.

TECHNOLOGY OF FRUITS AND VEGETABLES

Subject Code: BFOTS1-302 | **L T P C** **3 1 0 4** | **Duration: 60 (Hrs.)**

Course Objectives:

1. To understand nutritional profile, methods of preservations and indices of fruits and vegetables maturity.
2. To impart knowledge regarding process of canning of fruits and vegetables.
3. To summarize various quality characteristics of fruits and vegetables involved in their processing.
4. To develop value added products from fruits and vegetables using appropriate processing techniques and equipments.
5. To create awareness regarding utilization of fruits and vegetable industry wastes.

Course Outcomes:

1. Understanding nutritional profile, methods of preservations and indices of fruits and vegetables maturity.
2. Imparting knowledge regarding process of canning of fruits and vegetables.
3. Summarizing various quality characteristics of fruits and vegetables involved in their processing.
4. Developing value added products from fruits and vegetables using appropriate processing techniques and equipments.
5. Creating awareness regarding utilization of fruits and vegetable industry wastes.

UNIT-I (10 Hours)

Classification and nutritive value of fruits and vegetables, methods of preservation (short & long term), Physical and chemical indices of fruit maturity.

UNIT-II (10 Hours)

Quality characteristics of fruits and vegetables for processing.

Canning of fruits and vegetables: Selection of fruits and vegetables, process of canning, factors affecting the process- time and temperature, syrups and brines for canning.

UNIT-III (20 Hours)

Squashes, cordials, nectars, RTS, Syrups and blending of juices.

Jam: Constituents, selection of fruits, processing & technology, defects.

Jelly: Essential Constituents, Role of pectin, Theory of jelly formation, Processing & technology, defects.

UNIT-IV (20 Hours)

Pickles and sauces: Processing, Types, Causes of spoilage in pickling.

Processing of Tomato puree, paste, ketchup and sauce.

Dehydration of fruits and vegetables: Sun drying & mechanical dehydration.

Refrigeration of fruits and vegetable (Air blast freezing, immersion freezing, plate freezing, cryogenic freezing and IQF).

Utilization of fruits and vegetable industry wastes.

Recommended Text Books / Reference Books:

1. Khurdia DS, Preservation of fruits and vegetables. Indian Council of Agriculture Research, New Delhi 1995.
2. Potter N, Hotchkiss JH, Food Science. CBS Publishers, Delhi 2006.
3. Siddhapa GS, Lal G and Tandon, Preservation of fruits and vegetables, Indian Council of Agriculture Research, New Delhi, 1986.
4. Srivastava RS, Kumar S. Fruit and Vegetable Preservation; Principles and Practices, International Book Distributing Company, Lucknow, 2005.
5. Srivastava SS, Phal Parirakshan, Kitab Mahal, Lucknow, 2006.
6. Subbalakshmi G, Udipi SA, Food Processing and Preservation, New Age International Publishers, Delhi, 2007.

FOOD MICROBIOLOGY AND FOOD SAFETY

Subject Code: BFOTS1-303	**L T P C** **3 1 0 4**	**Duration: 60 (Hrs.)**

Course Objectives:

1. To understand the morphology of micro-organisms and their importance in foods.
2. To identify enumeration techniques involved in qualitative and quantitative determination of micro-organisms in food products.
3. To impart knowledge regarding different methods of preservation to prevent microbial spoilage of food products.
4. To differentiate between food infection and food intoxication and understand the microbiology of different raw and processed foods.
5. Creating awareness regarding types of hazards, food safety and management tools.

Course Outcomes:

1. Understanding the morphology of micro-organisms and their importance in foods.
2. Identification of enumeration techniques involved in qualitative and quantitative determination of micro-organisms in food products.
3. Imparting knowledge regarding different methods of preservation to prevent microbial spoilage of food products.
4. Differentiating between food infection and food intoxication and understand the microbiology of different raw and processed foods.
5. Creating awareness regarding types of hazards, food safety and management tools.

UNIT-I (15 Hours)

Types of Microorganisms in Food, Classification, Morphology and Structure of microorganisms, Importance in food (bacteria, fungi and viruses), Significance of spores.

UNIT-II (15 Hours)

Enumeration techniques & control of microorganisms in foods, Qualitative and quantitative methods-conventional as well as rapid, Principles and methods of preservation (thermal and non-thermal), Introduction to Hurdle Technology.

UNIT-III (15 Hours)

Microbiology of raw, processed and spoiled foods: Fruits and vegetables, Meat and meat products, milk and milk products, eggs, canned foods, cereals and cereal products. Food infection and Food intoxication.

UNIT-IV (15 Hours)

Introduction to Food Safety, Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting food safety. Sources of contamination, Control methods using physical and chemical agents, waste disposal, pest and rodent control, personnel hygiene. Food Safety Management Tools: HACCP, ISO series, TQM and Risk Analysis.

Recommended Text Books / Reference Books:

1. Frazier William C and Westhoff, Dennis C, Food Microbiology, TMH, New Delhi, 2004.
2. Jay, James M., Modern Food Microbiology, CBS Publication, New Delhi, 2000.
3. Garbutt, John., Essentials of Food Microbiology, Arnold, London,1997.
4. Pelczar MJ, Chan E.C.S and Krieg, Noel R , Microbiology, TMH, New Delhi, 1993.
5. Lawley, R., Curtis L. and Davis,J. , The Food Safety Hazard Guidebook , RSC Publication, 2004.
6. De Vries, Food Safety and Toxicity, CRC, New York, 1997.
7. Marriott, Norman G., Principles of Food Sanitation, AVI, New York, 1985.
8. Forsythe, S J., Microbiology of Safe Food, Blackwell Science, Oxford, USA, 1987.

DAIRY TECHNOLOGY LAB-IV

Subject Code: BFOTS1-304 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives:

1. To understand procedures and significance of platform tests in milk.
2. To determine different components of milk affecting its quality.
3. To impart knowledge regarding various equipments used in milk industry.
4. To develop various milk based products in compliance with legal specifications.
5. To create awareness regarding adulteration of milk and detection methods.

Course Outcomes:

1. Understanding procedures and significance of platform tests in milk.
2. Determination of different components of milk affecting its quality.
3. Imparting knowledge regarding various equipments used in milk industry.
4. Development of various milk based products in compliance with legal specifications.
5. Creating awareness regarding adulteration of milk and detection methods.

Practical's:

1. To perform platform tests in milk (Alcohol-Alizarin test, COB, MBRT, specific gravity).
2. To estimate milk fat by Gerber method.
3. Determination of titrable acidity and pH of milk.
4. To determine adulteration of milk.
5. Preparation of pasteurized milk.
6. Preparation of flavoured milk.
7. Preparation of Paneer.
8. To perform neutralization of cream.
9. To study the working of cream separator.
10. Preparation of butter and determination of overrun in butter.
11. Preparation of Ice-cream.
12. Preparation of shrikhand.
13. Preparation of ghee.
14. Visit to milk processing plant.

TECHNOLOGY OF FRUITS AND VEGETABLES LAB-V

Subject Code: BFOTS1-305 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives:

1. To understand the processing techniques involved in production of various value added products from fruits and vegetables meeting the specified needs of society.
2. To impart knowledge regarding quality parameters of products to meet legal specifications.
3. To analyze quality attributes of packaged food product.
4. To utilize by-products of fruits and vegetables industry for societal benefits and reducing environmental stress.
5. To create an ability to communicate the related issues during industrial visits.

Course Outcomes:

1. Understanding the processing techniques involved in production of various value-added products from fruits and vegetables meeting the specified needs of society.
2. Imparting knowledge regarding quality parameters of products to meet legal specifications.
3. Analyzing quality attributes of packaged food product.
4. Utilization of by-products of fruits and vegetables industry for societal benefits and reducing environmental stress.
5. Creating an ability to communicate the related issues during industrial visits.

Practical's:

1. Estimation of total soluble solids (TSS).
2. Estimation of brix: acid ratio.
3. Preparation of pickles.
4. Preparation of tomato paste.
5. Preparation of tomato ketchup and sauce.
6. Preparation of Jam and marmalades.
7. Preparation of Jelly.
8. Cut out analysis of canned food products.
9. Preparation of fruit preserve from Amla, Apple and carrot.
10. Preparation of Mango Leather.
11. Determination of dehydration and rehydration ratio of dehydrated vegetables.
12. Preparation of candied peels, glazed fruits and reformed fruits.
13. Visit to fruits and vegetable processing industry.

FOOD MICROBIOLOGY AND FOOD SAFETY LAB-VI

Subject Code: BFOTS1-306 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives:

1. To understand the application of various equipments used in microbiology.
2. To summarize methodologies and techniques involved in microbial analysis of different food commodities.
3. To describe the effect of various preservation methods on microbial load of different food products.
4. To analyze various food samples in terms of their pathogenic counts to ensure their safety for consumption.
5. To develop various fermented food products meeting the specified needs of population.

Course Outcomes:

1. Understanding the application of various equipments used in microbiology.
2. Summarizing the methodologies and techniques involved in microbial analysis of different food commodities.
3. Describing the effect of various preservation methods on microbial load of different food products.
4. Analyzing various food samples in terms of their pathogenic counts to ensure their safety for consumption.
5. Developing various fermented food products meeting the specified needs of population.

Practical's:

1. Sterilization and disinfection of equipment used in food microbiology laboratory.
2. Study of different types of microorganism colony shapes on agar plates.
3. Effect of extrinsic factors on growth of micro-organisms.
4. Effect of preservation methods on microbial load of different food samples.
5. Detection of food borne pathogens in a given food sample.
6. Isolation of fungi from food materials.
7. Study of incubation test of heated canned foods.
8. Study of Dye reduction test of milk.
9. Microbiological analysis of egg, cereal product and fruit product.
10. Spawn preparation of different mushrooms.
11. Production of red and white wine.
12. Production of vinegar.
13. Effect of sanitizers on microbial load.

ENTREPRENEURSHIP DEVELOPMENT

Subject Code: BFOTD1-311 | **L T P C** | **Duration: 45 (Hrs.)**

3 0 0 3

Course Objectives:

1. To understand the basics of Entrepreneur, Entrepreneurship and Enterprise for future prospectives.
2. To summarize entrepreneurial skills, techniques to develop, and assessment tests.
3. To interpret case studies of successful entrepreneurs in order to deal with different situations arising during Entrepreneurship.
4. To create an ability to identify opportunities in business and generation of unique business ideas.
5. To apply SWOT Analysis for business and for competitors.

Course Outcomes:

1. Understanding the basics of Entrepreneur, Entrepreneurship and Enterprise for future prospectives.
2. Summarizing entrepreneurial skills, techniques to develop, and assessment tests.
3. Interpreting case studies of successful entrepreneurs in order to deal with different situations arising during Entrepreneurship.
4. Creating an ability to identify opportunities in business and generation of unique business ideas.
5. Application of SWOT Analysis for business and for competitors.

UNIT-I (9 Hours)

Entrepreneur, Entrepreneurship and Enterprise: Concept and role in development, characteristics of entrepreneurs, developing entrepreneurial competencies, types of enterprise and ownership, charms of becoming an entrepreneur, reinforcing entrepreneurial motivation and competencies.

UNIT-II (12 Hours)

Entrepreneurial development

Case studies of successful entrepreneurs.

Exercises on ways of sensing opportunities – sources of idea, creating efforts, SWOT analysis.

Entrepreneurial skill assessment test.

Techniques of development of entrepreneurial skills, positive self-image and locus of control

UNIT-III (12 Hours)

Food business management
Case studies of Food processing business and its aspects.

Business opportunity identification and assessment techniques.

Business idea generation and evaluation exercise.

Market assessment study and analysis of competitive situation.

UNIT-IV (12 Hours)

SWOT Analysis for business and for competitors.

Preparation of business plan.

Preparation of project report.

Methods of arrangement of inputs–finance and material.

Recommended Text Books / Reference Books:

1. Vasant Desai, Fundamentals of Entrepreneurship and Small Business Management, Himalya Publishing House Pvt. Ltd., Mumbai, 2012.
2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalya Publishing House Pvt. Ltd., Mumbai, 2011.
3. D. David and S Erickson, Principles of Agri Business Management, Mc Graw Hill Book Co., New Delhi, 1987.
4. Acharya S S and Agarwal N L, Agricultural Marketing in India, Oxford & ISH Publishing Co., New Delhi, 1987.
5. David H. Holt, Entrepreneurship – Anew Venture Creation, Prentice Hall of India, New Delhi, 2002.
6. Phill Kottler, Marketing Management, Prentice Hall of India Private Limited, New Delhi, 1994.
7. Chandra, Prasanna, Projects, Planning, Analysis, Selection, Implementation and Review, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.

FOOD FERMENTATION TECHNOLOGY

Subject Code: BFOTD1-312 **L T P C** **Duration: 45 (Hrs.)**
3 0 0 3

Course Objectives:

1. To understand the basics of food fermentation.
2. To impart knowledge regarding design and operation of a bio-fermenter.
3. To identify types of starters useful for food industries.
4. To summarize the techniques involved in production of organic acids, vitamins, and yeast.
5. To create an ability to develop different types of fermented foods for desired health benefits.

Course Outcomes:

1. Understanding the basics of food fermentation.
2. Imparting knowledge regarding design and operation of a bio-fermenter.
3. Identification of different types of starters useful for food industries.
4. Summarizing the techniques involved in production of organic acids, vitamins, and yeast.
5. Creating an ability to develop different types of fermented foods for desired health benefits.

UNIT-I (10 Hours)

Introduction to fermentation technology, Principles of food fermentation, Types of fermentation (Continuous fermentation, Batch fermentation, Submerged fermentation and solid state fermentation), Microbial culture selection for fermentation.

UNIT-II (11 Hours)

Study of a Bio fermenter – its design and operation, Down Stream Processing and Product recovery.
Raw material availability, quality, processes and pre-treatments of raw materials. Major alcoholic raw materials.

UNIT-III (12 Hours)

Starter cultures, Types of starters used in Food Industry.
Fermented foods: methods of manufacture for vinegar, sauerkraut, Yoghurt, soya sauce, wine and traditional Indian foods, Fermented milk and products such as cheese, Fermented pickles.

UNIT-IV (12 Hours)

Production of organic acids (citric acid, lactic acid, gluconic acid and acetic acid), production of vitamins (Vitamin B2) and yeast (SCP).

Recommended Text Books / Reference Books:

1. Adams M & Moss, M., Food Microbiology. 2nd Edition, RSC Publishing, 2008.
2. Joshi V. K. & Pandey, A., Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2, Sanjanya Books, 1999.
3. John Garbutt, Essentials of Food Microbiology, Arnold International Students, 1997.
4. Brian J. Wood. Elsiever, Microbiology of Fermented Foods. Volume II and I, Applied Science Publication, 1997.
5. Stanbury, P.F., Whitekar A. and Hall, Principles of Fermentation Technology, Pergaman. McNeul and Harvey. (AC) NEW, 1995.

FOOD ADDITIVES

Subject Code: BFOTD1-313 | **L T P C 3 0 0 3** | **Duration: 45 (Hrs.)**

Course Objectives:

1. To understand the types, applications, and legal specifications of different food additives.
2. To impart knowledge regarding types, mode of action, and applications of different types of preservatives and flavoring agents.
3. To summarize the properties and applications of different types of sweeteners and emulsifiers used in food industries.
4. To create awareness regarding chemical composition, extraction procedures, and uses of different spices and condiments.
5. To differentiate between natural-, and synthetic food colors and their applications.

Course Outcomes:

1. Understanding the types, applications, and legal specifications of different food additives.
2. Imparting knowledge regarding types, mode of action, and applications of different types of preservatives and flavoring agents.
3. Summarizing the properties and applications of different types of sweeteners and emulsifiers used in food industries.
4. Creating awareness regarding chemical composition, extraction procedures, and uses of different spices and condiments.
5. Differentiating between natural-, and synthetic food colors and their applications.

UNIT-I (10 Hours)

Introduction to food additives: General Classification, types (On basis of their origin, natural and synthetic), uses, functions, legal aspects, risks and benefits

UNIT-II (11 Hours)

Preservatives: Antimicrobial agents, antioxidants and anti-browning agents (Types, mode of action and their applications in different food products)
Flavouring agents: Flavours (Natural and artificial), flavour enhancers, flavour stabilisation and flavour encapsulation.

UNIT-III (12 Hours)

Sweetners: Natural and artificial sweetners, Nutritive and non-nutritive sweetners, properties and uses of saccharin, aspartame, acesulfame-K, corn sweetners, invert sugar and sugar alcohols.
Emulsifiers: Types, selection of emulsifier, emulsion stability, functions and mechanism of action.

Stabilizers: Types, uses and functions

UNIT-IV (12 Hours)

Food Spices and condiments: Types and uses of spices and condiments, Chemical composition, Extraction and processing of Indian spices like pepper, cinnamon, cardamom, clove, ginger, turmeric, fenugreek and fennel, Seasonings and condiment blends.
Food Colors: Introduction, natural (biocolors) and synthetic food colors.

Recommended Books

1. A.L. Branen, 'Food Additives', Marcel Dekker Inc., New York, U.S.A.
2. J.W. Purseglove 'Spices' Longman Publishers, London, England.

3. D.R. Tainter and A.T. Grenis, 'Spices and Seasonings- A Food Technology Handbook', VCH Publishers, Inc., Hoboken, U.S.A.

4. J. Merory, 'Food Flavorings, Composition, Manufacture and Use', AVI Publishing Inc., Westport, U.S.A.

5. K.T. Farrell 'Spices, Condiments and Seasonings', Springer, U.S.A.

DRUG ABUSE

Subject Code: BMNCC0-004 **L T P C** **Duration: 30 (Hrs.)**
2 0 0 0

Course Objectives:

1. To understand the basics of drug abuse, drug dependence and drug addiction, and drug tolerance.
2. To identify nature of problem, sign, and symptoms associated with drug abuse.
3. To impart basic knowledge regarding causes and consequences of drug abuse.
4. To create awareness regarding prevention of drug abuse.
5. To analyze short term, long term effects and withdrawal symptoms of drug abuse.

Course Outcomes:

1. Understanding the basics of drug abuse, drug dependence and drug addiction, and drug tolerance.
2. Identification of nature of problem, sign, and symptoms associated with drug abuse.
3. Imparting basic knowledge regarding causes and consequences of drug abuse.
4. Creating awareness regarding prevention of drug abuse.
5. Analyzing short term, long term effects and withdrawal symptoms of drug abuse.

UNIT-I (10 Hours)

Problem of Drug Abuse: Concept and Overview; Types of Drug Often Abused
Concept and Overview
What are drugs and what constitutes Drug Abuse?
Prevalence of menace of Drug Abuse
How drug Abuse is different from Drug Dependence and Drug Addiction?
Physical and psychological dependence- concepts of drug tolerance
Introduction to drugs of abuse: Short Term, Long term effects & withdrawal symptoms
Stimulants: Amphetamines, Cocaine, Nicotine
Depressants: Alcohol, Barbiturates- Nembutal, Seconal, Phenobarbital Benzodiazepines –Diazepam, Alprazolam, Flunitrazepam
Narcotics: Opium, morphine, heroin
Hallucinogens: Cannabis & derivatives (marijuana, hashish, hash oil), Steroids and inhalants

UNIT-II (8 Hours)

Nature of the Problem
Vulnerable Age Groups

Signs and symptoms of Drug Abuse

(a)- Physical indicators

(b)- Academic indicators

(c)- Behavioural and Psychological indicators

UNIT-III (6 Hours)

Causes and Consequences of Drug Abuse
Causes
Physiological

Psychological
Sociological
Consequences of Drug Abuse
For individuals
For families
For society & Nation

UNIT-IV (6 Hours)

Management & Prevention of Drug Abuse
Management of Drug Abuse
Prevention of Drug Abuse
Role of Family, School, Media, Legislation & Deaddiction Centres

Recommended Text Books / Reference Books:

1. Kapoor. T., Drug Epidemic among Indian Youth, Mittal Pub, New Delhi, 1985.
2. Modi, Ishwar and Modi, Shalini, Drugs: Addiction and Prevention, Rawat Publication, Jaipur, 1997.
3. Ahuja, Ram, Social Problems in India, Rawat Publications, Jaipur, 2003.
4. National Household Survey of Alcohol and Drug Abuse. New Delhi, Clinical Epidemiological Unit, All India Institute of Medical Sciences, 2004.
5. World Drug Report , United Nations Office of Drug and Crime,2011
6. World Drug Report, United nations Office of Drug and Crime, 2010.
7. Extent, Pattern and Trend of Drug Use in India, Ministry of Social Justice and Empowerment, Government of India, 2004.
8. The Narcotic Drugs and Psychotropic Substances Act, 1985, New Delhi: Universal, 2012.

SEMESTER FOURTH

TECHNOLOGY OF CEREALS, PULSES AND OIL SEEDS

Subject Code: BFOTS1-401 **L T P C** **Duration: 60 (Hrs.)**
3 1 0 4

Course Objectives:

1. To understand the structure, composition, and physico-chemical properties of cereals, pulses and oilseeds.
2. To impart knowledge regarding milling of cereals and pulses.
3. To familiarize students with extraction and processing of fats and oils.
4. To develop value added products from cereals, pulses and oilseeds.
5. To create awareness regarding advantages and disadvantages of steps involved in processing of cereals, pulses and oilseeds.

Course Outcomes:

1. Understanding the structure, composition, and physico-chemical properties of cereals, pulses and oilseeds.
2. Imparting knowledge regarding milling of cereals and pulses.
3. Familiarizing students with extraction and processing of fats and oils.
4. Development of value added products from cereals, pulses and oilseeds.
5. Creating awareness regarding advantages and disadvantages of steps involved in processing of cereals, pulses and oilseeds.

UNIT-I (15 Hours)

Wheat-Structure and chemical composition of wheat grain, Types, milling, flour grade, flour treatments (bleaching, maturing), flour for various purposes, bread, biscuit, cake manufacturing.

UNIT-II (15 Hours)

Rice – Structure and chemical composition of rice grain, physicochemical properties, milling, parboiling of rice, changes during parboiling, Advantages and disadvantages of parboiling, ageing of rice

UNIT-III (15 Hours)

Corn – Milling (wet & dry), cornflakes, corn starch and corn sweeteners.
Barley- Milling, Malting of barley: steeping, Germination and drying.
Sorghum and millets – Milling and uses.

UNIT-IV (15 Hours)

Milling of pulses: Dry milling, wet milling, improved milling methods
Technology of oil seeds
Extraction of oil and refining.
Preparation of defatted flour, protein concentrates, isolates, Uses.

Recommended Text Books / Reference Books:

1. Kent, N.L., Technology of Cereal, 5th Ed., Pergamon Press, 2003.
2. Chakraverty, Post Harvest Technology of Cereals, Pulses and Oilseeds, revised Ed., Oxford & IBH Publishing Co. Pvt Ltd., 1988.
3. Marshall, Rice Science and Technology, Wadsworth, New York, 1994.
4. Manay, S. and Sharaswamy, M., Food Facts and Principles, Wiley Eastern Limited, 1994.

EGG, POULTRY AND MEAT TECHNOLOGY

Subject Code: BFOTS1-402

L	T	P	C
3	1	0	4

Duration: 60 (Hrs.)

Course Objectives:

1. To understand the chemical composition and nutritive value of egg, meat and poultry.
2. To impart knowledge regarding packaging, spoilage and preservation of egg, meat and poultry.
3. To apply ethical principles during handling of animal and their conversion into meat and other products.
4. To analyze quality parameters of eggs, meat and poultry.
5. To create awareness regarding by product utilization of meat industry.

Course Outcomes:

1. Understanding the chemical composition and nutritive value of egg, meat and poultry.
2. Imparting knowledge regarding packaging, spoilage and preservation of egg, meat and poultry.
3. Application of ethical principles during handling of animal and their conversion into meat and other products.
4. Analysis of quality parameters of eggs, meat and poultry.
5. Creating awareness regarding by product utilization of meat industry.

UNIT-I (15 Hours)

Egg: Structure and composition, Nutritive value and functional properties. Quality of egg: Interior quality evaluation, candling, grading, handling, packaging, storage, transportation. Egg powder. Liquid egg preservation. Packaging and transportation of eggs.

UNIT-II (15 Hours)

Poultry: Types, chemical and nutritive value of poultry meat.
Poultry dressing and slaughtering methods.
Preservation, grading and packaging of poultry meat.

UNIT-III (15 Hours)

Status and scope of meat industry in India. Ante-mortem and post-mortem examination of meat animal, their slaughtering and dressing. Structure and physico-chemical properties of muscle. Post-mortem changes in meat. Ageing of meat, meat tenderization-natural and artificial methods. Quality Parameters: Meat color, water holding capacity, Marbling, Firmness and factors affecting it.

UNIT-IV (15 Hours)

Restructured meat products, meat analogs.
Preservation and spoilage of meat.
Meat industry by products: Importance and utilization.

Recommended Text Books / Reference Books:

1. Lawrie R A, Lawrie's, Meat Science, 5th Ed, Woodhead Publisher, England, 1998.
2. Parkhurst & Mountney, Poultry Meat and Egg Production, CBS Publication, New Delhi, 1997.
3. Pearson & Gillet Processed Meats, 3rd Ed, CBS Publication, New Delhi, 1997.
4. Shai Barbut, Poultry Products Processing, CRC Press, 2005.
5. Stadelman WJ, Owen J Cotterill Egg Science and Technology, 4th Ed. CBS Publication New Delhi, 2002.
6. Romans. JR and Costllo WJ, Carlson WC, Greaser, ML and Jones KW, The Meat we eat, Interstate Publishers, USA, 2004.

FOOD PLANT HYGIENE AND SANITATION

Subject Code: BFOTS1-403 **L T P C** **Duration: 60 (Hrs.)**
3 1 0 4

Course Objectives:

1. To understand the concept and importance of personal hygiene and its role in food safety.
2. To impart knowledge regarding principles and methods of cleaning and sanitation.
3. To design layout of ETP plants keeping in view all the requirements of food processing industry.
4. To develop value added products from wastes of food industry.
5. To create awareness regarding disposal and treatment of waste.

Course Outcomes:

1. Understanding the concept and importance of personal hygiene and its role in food safety.
2. Imparting knowledge regarding principles and methods of cleaning and sanitation.
3. Designing the layout of ETP plants keeping in view all the requirements of food processing industry.
4. Development of value added products from wastes of food industry.
5. Creating awareness regarding disposal and treatment of waste.

UNIT-I (15 Hours)

Introduction:
Importance of personal hygiene of food handler-habits, clothes, illness, education of handler in

Handling and service.

UNIT-II (15 Hours)

Industrial Hygiene:
Cleaning methods – sterilization, disinfection, heat & chemicals, chemical tests for sanitizer strength. Cleaning agents and disinfectants.

Food sanitation-Principles & methods, control, inspection. Sanitation in fruits & vegetables industry, cereals industry, dairy industry, meat, egg & poultry units.

UNIT-III (15 Hours)

Waste disposal, Control methods using physical and chemical agents, Pest and rodent control, ETP design and layout. Food storage sanitation, transport sanitation and water sanitation.

UNIT-IV (15 Hours)

By-products utilization obtained from dairy plant, egg & poultry processing industry and meat industry. Wastewater and solid waste treatment: Waste-types-solid and liquid waste characterization, physical, chemical, biological, aerobic, anaerobic, primary, secondary and tertiary (advanced) treatments.

Recommended Text Books / Reference Books:

1. Norman G. Marriott and Robert B. Gravani, Principles of Food Sanitation, 5th edition, 2006.
2. Rao, D. G., Fundamentals of Food Engineering, PHI learning Private Ltd., 2010.
3. Fellows P., Food Processing Technology, 2nd Edition. Woodhead Publishing Limited and CRC Press LLC, 2000.
4. James A, The supply chain handbook, distribution group, 2013.
5. FAO, US, Design and operations of cold store in developing, 1984.

TECHNOLOGY OF CEREALS, PULSES AND OILSEEDS LAB-VII

Subject Code: BFOTS1-404 **L T P C** **Duration: 60 (Hrs.)**

0 0 4 2

Course Objectives:

1. To impart knowledge regarding proximate composition of flour and its analysis.
2. To familiarize students with processing of cereals, pulses and oilseeds.
3. To develop value added products from cereals, pulses and oilseeds.
4. To analyze physico-chemical characteristics of grains and flour relating to product quality.
5. To create awareness regarding adulteration of fats and oils and detection techniques.

Course Outcomes:

1. Imparting knowledge regarding proximate composition of flour and its analysis.
2. Familiarizing the students with processing of cereals, pulses and oilseeds.
3. Development of value added products from cereals, pulses and oilseeds.
4. Analysis of physico-chemical characteristics of grains and flour relating to product quality.
5. Creating awareness regarding adulteration of fats and oils and detection techniques.

PRACTICALS:

1. Physical characteristics of cereal grains.
2. Proximate analysis of wheat flour (moisture, ash, fat, protein and crude fiber content).
3. Estimation of gluten content of flour.
4. Estimation of Polenske value of flour.
5. Estimation of alkaline water retention capacity of flour.
6. Determination of sedimentation value of flour
7. Cooking characteristics of rice.
8. Experimental parboiling of rice by different methods.
9. Determination of soaking and hydration capacity of pulses.
10. Preparation of full fat and defatted soya flour.
11. Extraction of oil from groundnuts.
12. Determination of saponification value.
13. Detection of adulteration of cotton seed oil and ground nut oil.
14. Visit to cereal and oilseed processing industry.

EGG, POULTRY AND MEAT TECHNOLOGY LAB-VIII

Subject Code: BFOTS1-405 | **L T P C** **0 0 4 2** | **Duration: 60 (Hrs.)**

Course Objectives:

1. To determine the proportion of different constituents present in eggs
2. To impart knowledge regarding techniques involved in grading and quality evaluation of eggs, poultry and meat products.
3. To familiarize students about ethical principles of slaughtering and dressing for the conversion of muscles into meat.
4. To formulate value added products from eggs, poultry, and meat to meet needs of society.
5. To create awareness regarding various methods used to preserve eggs, poultry, and meat.

Course Outcomes:

1. Determination of different constituents present in eggs
2. Imparting knowledge regarding techniques involved in grading and quality evaluation of eggs, poultry and meat products.
3. Familiarizing students about ethical principles of slaughtering and dressing for the conversion of muscles into meat.
4. Formulating value added products from eggs, poultry, and meat to meet needs of society.
5. Creating awareness regarding various methods used to preserve eggs, poultry, and meat.

Practical's:

1. Determination of moisture and ash contents of egg components.
2. Determination of percentage of various egg constituents
3. Grading and Quality evaluation of eggs.
4. Preservation of shell eggs by various methods.
5. Candling of eggs.
6. Determination of time temperature condition on formation of iron sulphide in egg.
7. Preparation of egg products: boiled, fried, poached, scrambled, poached.
8. Preparation of egg pickle
9. Slaughtering and dressing of poultry.
10. Post mortem examination of poultry meat and identifying different parts of poultry.
11. Preservation of meat by pickling method.
12. Preparation of different meat products.
13. Evaluation of meat quality.
14. Visit to poultry and meat industry.

FOOD PLANT HYGIENE AND SANITATION LAB-IX

Subject Code: BFOTS1-406	L T P C	Duration: 60 (Hrs.)
	0 0 4 2	

Course Objectives:

1. To understand the importance of sterilization of equipments and different ways to achieve the same.
2. To impart knowledge regarding methodology and significance of BOD and COD.
3. To familiarize the students with importance of cleaning and sanitation of equipments in the plant and methods to ensure the same.
4. To analyze microbial load of air, workplace, and equipments.
5. To create awareness regarding evaluation of different quality parameters of water.

Course Outcomes:

1. Understanding the importance of sterilization of equipments and different ways to achieve the same.
2. Imparting knowledge regarding methodology and significance of BOD and COD.
3. Familiarizing the students with importance of cleaning and sanitation of equipments in the plant and methods to ensure the same.
4. Analysis of microbial load of air, workplace, and equipments.
5. Creating awareness regarding evaluation of different quality parameters of water.

Practical's:

1. Sterilization of equipments used in the laboratory by using heat and chemicals.
2. Determination of B.O.D
3. Determination of C.O.D
4. Determination of sanitary status of plant equipment.
5. Measurement of Chlorine content in water.
6. Measurement of hardness of water.
7. Measurement of quality parameters and chemical analysis of water.
8. Determination of microbial load of air.
9. Determination of microbial load of workplace.
10. Determination of microbial load of equipments using swab test.

NUTRACEUTICAL AND FUNCTIONAL FOODS

Subject Code: BFOTD1-411	**L T P C**	**Duration: 60 (Hrs.)**
	4 0 0 4	

Course Objectives:

1. To understand the basics of nutraceuticals, their types and importance.
2. To impart knowledge regarding different food commodities with potential to be used as functional foods.
3. To familiarize students with fermented foods and their role in addressing specific needs of society.
4. To develop an ability to differentiate between nutraceuticals and functional foods.
5. To create awareness regarding nutraceuticals and functional foodsand their potential role in human health.

Course Outcomes:

1. Understanding the basics of nutraceuticals, their types and importance.
2. Imparting knowledge regarding different food commodities with potential to be used as functional foods.
3. Familiarizing students with fermented foods and their role in addressing specific needs of society.
4. Developing an ability to differentiate between nutraceuticals and functional foods.
5. Creating awareness regarding nutraceuticals and functional foods and their potential role in human health.

UNIT-I (15 Hours)

Introduction

Background, definitions, difference between nutraceuticals and functional foods, types of nutraceutical compounds and their health benefits, current scenario.

UNIT-II (15 Hours)

Nutraceuticals

Types of nutraceutical compounds – Phytochemicals, phytosterols and other bioactive compounds, peptides and proteins, carbohydrates (dietary fibers, oligosaccharides and resistant starch).

Prebiotics, probiotics and synbiotics.

Lipids (Conjugated Linoleic Acid, omega-3 fatty acids, fat replacers), vitamins and minerals; their sources and role in promoting human health.

UNIT-III (15 Hours)

Functional Foods

Cereal and cereal products, milk and milk products, egg, oils, meat and products, sea foods, nuts and oilseeds, functional fruits and vegetables, herbs and spices, beverages (tea, wine etc)

UNIT-IV (15 Hours)

Fermented foods – their health benefits and role in conditions like cardiovascular diseases, hypertension, diabetes etc. Future prospects of functional foods and nutraceuticals and their potential for use in improving health.

Recommended Text Books / Reference Books:

1. Wildman REC, Handbook of Nutraceutical and Functional Foods, CRC Press, 2001.
2. Ghosh D et al, Innovations in Healthy and Functional Foods, CRC Press, 2012.
3. Pathak YV, Handbook of nutraceuticals Volume 2, CRC Press, 2011.

NUTRACEUTICAL AND FUNCTIONAL FOODS LAB X

Subject Code: BFOTD1-412	**L T P C** **0 0 4 2**	**Duration: 60 (Hrs.)**

Course Objectives:

1. To identify various Nutraceuticals and functional foods available in the market.
2. To impart knowledge regarding compounds responsible for imparting nutraceutical and functional properties to the food product.
3. To develop various functional foods adhering to legal specifications.
4. To analyze different food components which may act as nutraceuticals and functional foods.
5. To create awareness regarding health benefits of Nutraceuticals and functional foods.

Course Outcomes:

1. Identification of various nutraceuticals and functional foods available in the market.
2. Imparting knowledge regarding compounds responsible for imparting nutraceutical and functional properties to the food product.
3. Development of various functional foods adhering to legal specifications.
4. Analysis of different food components which may act as nutraceuticals and functional foods.
5. Creating awareness regarding health benefits of nutraceuticals and functional foods.

PRACTICALS

1. Identification of various nutraceuticals and functional foods available in the market
2. Estimation of chlorophyll content of green vegetable
3. Determination of lycopene in fruit/vegetable
4. Determination of total pectin in plant material
5. Estimation of crude fibre/dietary fibre content in cereals and their products
6. Estimation of anthocyanins in food sample
7. Determination of Vitamin C content of sample
8. Preparation and evaluation of probiotic/prebiotic foods
9. Determination of antioxidant activity in food.
10. Determination of total phenolic content in foods
11. Determination of total flavonoids content in foods
12. Development of functional foods.

BAKERY TECHNOLOGY

Subject Code: BFOTD1-413 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives:

1. To familiarize the students with current scenario and economic importance of Bakery industry in India.
2. To understand the role of different ingredients used in the formulation of different bakery products.
3. To impart knowledge regarding processing techniques involved in manufacturing of various baked products.
4. To create awareness regarding quality attributes of different bakery products.
5. To develop modified bakery products addressing specific needs of society.

Course Outcomes:

1. Familiarizing the students with current scenario and economic importance of Bakery industry in India.
2. Understanding the role of different ingredients used in the formulation of different bakery products.
3. Imparting knowledge regarding processing techniques involved in manufacturing of various baked products.
4. Creating awareness regarding quality attributes of different bakery products.
5. Development of modified bakery products addressing specific needs of society.

UNIT-I (15 Hours)

Bakery industry: Current status, growth rate, and economic importance of Bakery Industry in India. Product types, nutritional quality.

UNIT-III (15 Hours)

Bread: Ingredients, bread making process, faults and corrective measures
Cakes: Ingredients, cake making process, different types of icings.

UNIT-III (15 Hours)

Biscuits, cookies & crackers
Technology of biscuit, cookies and cracker manufacturing. Baking powders as leavening agents in bakery industry.
Modified bakery products
Modification of bakery products for people with special nutritional requirements e.g. high fiber, low sugar, low fat, gluten free bakery products.

UNIT-IV (15 Hours)

Breakfast cereals, macaroni products and malt
Production and quality of breakfast cereals, macaroni products and malt.

Recommended Text Books / Reference Books:

1. Dubey, S.C., Basic Baking 5th Ed., Chanakya Mudrak Pvt. Ltd., 2007.
2. Raina et.al., Basic Food Preparation-A complete Manual. 3rd Ed., Orient Longman Pvt. Ltd., 2003.
3. Manay, S. & Shadaksharaswami, M., Foods: Facts and Principles, New Age Publishers, 2004.
4. Barndt R. L., Fat & Calorie – Modified Bakery Products, Springer US, 1993.
5. Samuel A. Matz, Bakery Technology and Engineering, PAN-TECH International Incorporated, 1999.
6. Faridi Faubion , Dough Rheology and Baked Product Texture, CBS Publications, 1997.
7. Samuel A. Matz, Cookies & Cracker Technology, Van Nostrand Reinhold, 1992.

BAKERY TECHNOLOGY LAB XI

Subject Code: BFOTD1-414 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives:

1. To impart knowledge regarding selection of ingredients for the development of various baked products and ensuring their safety to the allergic persons.
2. To familiarize students with methodologies of sensory evaluation of baked products.
3. To determine various quality attributes of baked products.
4. To develop various baked products adhering to legal standards.
5. To create awareness regarding ingredients falling under category of allergens as per legal standards.

Course Outcomes:

1. Imparting knowledge regarding selection of ingredients for the development of various baked products and ensuring their safety to the allergic persons.
2. Familiarizing students with methodologies of sensory evaluation of baked products.
3. Determination of various quality attributes of baked products.
4. Development of various baked products adhering to legal standards.
5. Creating awareness regarding ingredients falling under category of allergens as per legal standards.

Practical's:

1. Preparation of bread and assessment of its quality
2. Estimation of fermentation power of yeast.
3. Preparation of buns and assessment of quality
4. Preparation of cake and assessment of its quality.
5. Icing of cake.
6. Preparation of cookies and assessment of quality.
7. Preparation of biscuits and assessment of quality.
8. Sensory evaluation of bakery products.
9. Preparation of gluten free biscuits from pseudo cereals.
10. Preparation of low calorie biscuits and cakes.
11. Preparation of high fiber biscuits and cakes.
12. Preparation of pasta and evaluation of its quality.
13. Visit to local bakery.

SEMESTER FIFTH

UNIT OPERATIONS IN FOOD ENGINEERING

Subject Code: BFOTS1-501 **L T P C 3 1 0 4** **Duration: 60(Hrs.)**

Course Objectives:

1. To understand the basics of unit operations.
2. To impart knowledge regarding methods of cleaning, sorting, grading, and size reduction.
3. To familiarize students with low-temperature, and high-temperature unit operations and their applications in food industry.
4. To formulate and analyze the problems related to unit operations used in food engineering.
5. To create awareness regarding selection and application of appropriate tools and techniques used in food industry.

Course Outcomes:

1. Understanding the basics of unit operations.
2. Imparting knowledge regarding methods of cleaning, sorting, grading, and size reduction.
3. Familiarizing students with low-temperature, and high-temperature unit operations and their applications in food industry.
4. Formulating and analyzing the problems related to unit operations used in food engineering.
5. Creating awareness regarding selection and application of appropriate tools and techniques used in food industry.

UNIT I (12 Hrs.)

Introduction: Concept of unit operations
Preliminary Unit Operations: Material handling; Conveyors and elevators, types of conveyors and elevators.

UNIT II (17 Hrs.)

Cleaning: Dry-cleaning; screening, aspiration and magnetic cleaning, wet cleaning; soaking, spray washing, ultrasonic washing, sorting and grading: methods, advantages of sorting and grading
Size reduction: Benefits, criteria for size reduction, size reduction of solid, fibrous and liquid foods.

UNIT III (16 Hrs.)

Refrigeration and Freezing: Refrigeration, components of refrigeration system, compressors, condensers and expansion valve, selection of refrigerant, cooling load, coefficient of performance, refrigerant flow rate.
Direct contact and indirect freezing systems.

UNIT IV (15 Hrs.)

High temperature operations: Pasteurization, pasteurizer and its functioning.
Evaporation: Single effect evaporators and multiple effect evaporators, natural and forced circulations, falling and rising film evaporators.

Recommended Readings

1. Rao D. G., 'Fundamentals of Food Engineering', PHI learning private ltd.,2010.
2. Singh R. P. and Heldman D. R., 'Introduction to Food Engineering', Academic press 2nd, 3rd and 4th Edition, 1993, 2003,2009.
3. Rao C.G., 'Essentials of Food Process Engineering', B.S. publications,2006.
4. Fellow P., Food Processing Technology,1988.

FOOD PACKAGING

Subject Code: BFOTS1-502 **L T P C** **Duration: 60(Hrs.)**
3 1 0 4

Course Objectives:

1. To understand the basics of food packaging.
2. To impart knowledge regarding different types of packaging materials and their suitability for packaging of different food products.
3. To familiarize students with various types of packaging machinery and systems.
4. To develop eco-friendly packaging and addressing environmental concerns.
5. To create awareness regarding novel methods of food packaging and communicating its benefits to consumers.

Course Outcomes:

1. Understanding the basics of food packaging.
2. Imparting knowledge regarding different types of packaging materials and their suitability for packaging of different food products.
3. Familiarizing students with various types of packaging machinery and systems.
4. Development of eco-friendly packaging and addressing environmental concerns.
5. Creating awareness regarding novel methods of food packaging and communicating its benefits to consumers.

UNIT I (15 Hrs.)

Introduction to Food Packaging
Packaging Functions and Requirements, Printing of packages, Barcodes & other marking, Labelling Laws

UNIT II (16 Hrs.)

Food Packaging Materials: Paper and paper-based materials, corrugated fiber board (CFB). Plastics, formation- Injection molding, Blow molding, Types of plastics, Lamination, Biodegradable plastics, Edible packaging and Bio-composites. Environmental Concerns recycling and disposal of plastic waste.

UNIT III (14 Hrs.)

Metal packaging- Metals: Tinplate, tinning process, components of tinplate, tin free can (TFC) types of can, metallic films, lacquers
Glass: Composition, Properties, Methods of bottle making, Types of closures.

UNIT IV (15 Hrs.)

Packaging Machinery and Systems: Bottling machines, Cartoning systems, Seal and Shrink packaging machine; Form, Fill and Sealing machine(FFS).
Vacuum, Controlled and Modified atmosphere packaging systems; Aseptic packaging systems; Retort packaging, Active and Intelligent packaging systems

Recommended Readings:

1. Robertson G. L., 'Food Packaging – Principles and Practice', CRC Press Taylor and Francis Group,2012.
2. Paine F.A. and Paine H.Y., 'A Handbook of Food Packaging', Blackie Academic and Professional,1992.
3. Coles R., McDowell D. and Kirwan M. J., 'Food Packaging Technology', Blackwell, 2003.

SUGAR AND CONFECTIONARY TECHNOLOGY

Subject Code: BFOTS1-503 | **L T P C 4 0 0 4** | **Duration: 60(Hrs.)**

Course Objectives:

1. To understand the manufacturing process and deterioration of sugar.
2. To impart knowledge regarding different types of icings and toppings.
3. To familiarize students with different types of confectionary products. .
4. To develop various value added products from cocoa and understand associated defects.
5. To create awareness regarding by-products of sugar industry and their utilization in an eco-friendly manner and for societal benefits.

Course Outcomes:

1. Understanding the manufacturing process and deterioration of sugar.
2. Imparting knowledge regarding different types of icings and toppings.
3. Familiarizing students with different types of confectionary products. .
4. Development of various value added products from cocoa and understand associated defects.
5. Creating awareness regarding by-products of sugar industry and their utilization in an eco-friendly manner and for societal benefits.

UNIT-I (15 Hrs.)

Composition and characteristics of cane juice, Cane juice extraction. Manufacturing of sugar. Deterioration of sugars during storage & transportation and its prevention, By-products of sugar industry and their utilization.

UNIT-II (15 Hrs.)

Icings and Toppings: Fondant, American frosting, Butter cream icing, royal icing, gum paste, glace icing, marshmallow, almond paste and fudge.

UNIT III (15 Hrs.)

Chocolates: Cocoa processing, Cocoa liquor, Cocoa butter. Cocoa powder and chocolate manufacturing Chocolate tempering and lipid crystallization, Chocolate enrobing and chocolate defects.

UNIT-IV (15Hrs.)

Classification of confectionary: Hard and soft boiled sugar confectionary; fondant, fudge, caramel, toffee butterscotch, Sugar panning, hard boiled candy.

Recommended Books:

1. Minife B.W, 'Chocolate, Cocoa and Confectionary: Science & Technology', AVI Publishing Co., New York, 1997.
2. Mathur R.B.L., 'Handbook of Cane Sugar Technology', Oxford & IBH Publishing Co., New Delhi,1986.
3. Faridi H., 'The Science of Cookie & Cracker Production', Chapman & Hall, UK,1994.

FOOD PACKAGING LAB XII

Subject Code: BFOTS1-504 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives:

1. To impart knowledge regarding testing of physico-mechanical parameters of packaging materials.
2. To familiarize students regarding different types of packaging machinery.
3. To analyze various quality parameters of different packaging materials and packaged food products.
4. To develop edible packaging for food products.
5. To create awareness regarding effect of packaging on shelf life of food products.

Course Outcomes:

1. Imparting knowledge regarding testing of physico-mechanical parameters of packaging materials.
2. Familiarizing students regarding different types of packaging machinery.
3. Analysis of various quality parameters of different packaging materials and packaged food products.
4. Development of edible packaging for food products.
5. Creating awareness regarding effect of packaging on shelf life of food products.

PRACTICALS

1. Testing of physical/mechanical properties of food packaging materials.
2. Testing of thermal shock resistance of glass.
3. Gas/Vacuum packaging of foods
4. To Study the effect of packaging on shelf life of food products.
5. Determination of Water Vapor Transmission Rate of Packaging Material.
6. Edible packaging of Food Samples.
7. Study of Sorption Isotherm for Food Package Design.
8. Packaged food cut-out analysis.
9. To study the operation of FFS machine.

Recommended Readings:

1. Robertson G.L., 'Food Packaging – Principles and Practice', CRC Press Taylor and Francis Group, 2012.
2. Paine F.A. and Paine H.Y., A Handbook of Food Packaging, Blackie Academic and Professional, 1992.
3. Coles R., McDowell D. and Kirwan M. J., 'Food Packaging Technology', Blackwell, 2003.

SUGAR AND CONFECTIONARY TECHNOLOGY LAB XIII

Subject Code: BFOTS1-505 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objective:

1. To understand the effect of different processing conditions on sugar.
2. To impart knowledge regarding instruments used for the analysis of various quality parameters of confectionary products.
3. To familiarize students with different types of packaging used for confectionary products.
4. To develop the ability to prepare various types of sugar and confectionary products.
5. To analyze sensorial attributes of various confectionary products.

Course Outcomes:

1. Understanding the effect of different processing conditions on sugar.
2. Imparting knowledge regarding instruments used for the analysis of various quality parameters of confectionary products.
3. Familiarizing students with different types of packaging used for confectionary products.
4. Developing ability to prepare various types of sugar and confectionary products.
5. Analysis of sensorial attributes of various confectionary products.

PRACTICAL

1. Determine the effect of heat on sugar solution and perform the thread and cold water test.
2. To study the process of inversion, melting and caramelization in sucrose.
3. Preparation of fondant, fudge and brittles.
4. Preparation of Shakarpara and Chhanamurki.
5. Preparation of candy and toffee and to perform quality assessment tests.
6. Preparation of cake decorations.
7. Collection of various types of confectionary packages.
8. Determination of sugar in confectionary product by saccharometer.
9. Determination of refractive index of sugar – solutions of different consistencies.
10. Organoleptic testing of different confectionary products.
11. Visit to sugar and confectionary industry.

Recommended Readings:

1. Raina et.al., 'Basic Food Preparation-A complete Manual', 3rd Edition, Orient Longman Pvt. Ltd., 2003.
2. Manay, S. and Shadaksharaswami, M., 'Foods: Facts and Principles', New Age Publishers, 2004.
3. Beckette S.T., 'Industrial Chocolate Manufacture', Blackwell Publishing Ltd., 2009. 4.Minifie B.W. , 'Chocolate, Cocoa and Confectionary', Aspen Publications,1999.
4. Mohini S. and Eram R., 'Food science- Experiments and applications', 2nd Edition., CBS publishers & Distributors Pvt. Ltd.2011.

SPICES AND FLAVOUR TECHNOLOGY

Subject Code: BFOTD1-511 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives:

1. To understand types, chemical composition, processing, and applications of different spices.
2. To impart knowledge regarding processing of spices.
3. To familiarize students with packaging of spices and spice products.
4. To summarize about different flavoring compounds and their stability during processing.
5. To create awareness regarding microbial contamination and insect infestation in spices and its control.

Course Outcomes:

1. Understanding types, chemical composition, processing, and applications of different spices.
2. Imparting knowledge regarding processing of spices.
3. Familiarizing students with packaging of spices and spice products.
4. Summarizing about different flavoring compounds and their stability during processing.
5. Creating awareness regarding microbial contamination and insect infestation in spices and its control.

UNIT I (15 Hrs.)

Classification & use of spices, Chemical constituents of spices, Processing of white pepper. Dehydration products of onion, garlic.

UNIT-II (15 Hrs.)

Cryomilling of spices. Spice oleoresins and spice emulsion. Packaging of spices and spice products. Microbial contamination and insect infestation in spices and its control.

UNIT-III (16 Hrs.)

Classification of flavouring compounds. Stability of flavourings. Flavor encapsulation Processing of Cocoa and Coffee.

UNIT IV (14 Hrs.)

Processing of white pepper, cardamom, cinnamon, cloves, turmeric, ginger, fenugreek and fennel.

Recommended Books:

1. Peter K.V., 'Handbook of Spices', Woodhead Publishers, UK, 2001.
2. Pruthi, J. S., 'Spices and Condiments', NBT India, 1976.
3. Spice Statistics by Spices Board, GOI, Cochin, 2007.

SPICES AND FLAVOUR TECHNOLOGY LAB XIV

Subject Code: BFOTD1-512 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objective:

1. To impart knowledge regarding proximate composition of spices.
2. To familiarize students regarding organoleptic evaluation of flavoring compounds and their role in different food products.
3. To understand the methods used to assess quality of spices.
4. To analyze microbiological quality of spices in order to ensure their safety for human consumption.
5. To create awareness regarding adulteration of spices and their detection methods.

Course Outcomes:

1. Imparting knowledge regarding proximate composition of spices.
2. Familiarizing students regarding organoleptic evaluation of flavoring compounds and their role in different food products.
3. Understanding the methods used to assess quality of spices.
4. Analysis of microbiological quality of spices in order to ensure their safety for human consumption.
5. Creating awareness regarding adulteration of spices and their detection methods

PRACTICAL

1. Determination of moisture in ground spices.
2. Determination of total ash in spices.
3. Determination of extraneous matter in spices.
4. Determination of pungency rating (Scoville method) in Red Pepper.
5. Adulteration tests for different spices.
6. Organoleptic evaluation of flavours.
7. Identification of Saffron by sulphuric – diphenylamine test.
8. To evaluate microbiological quality of spices.

Recommended Books:

1. Peter K.V., 'Handbook of Spices', Woodhead Publishers, UK,2001.
2. Pruthi, J. S., 'Spices and Condiments', NBT India,1976.
3. Spice Statistics by Spices Board, GOI, Cochin,2007.

TECHNOLOGY OF OILS AND FATS

Subject Code: BFOTD1-513 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives:

1. To understand the basics of fats and oils.
2. To impart knowledge regarding processing of fats and oils.
3. To familiarize students with deteriorative changes in fats and oils.
4. To analyze physico-chemical properties of fats and oils.
5. To create awareness about nutritional importance of oils and fats.

Course Outcomes:

1. Understanding the basics of fats and oils.
2. Imparting knowledge regarding processing of fats and oils.
3. Familiarizing students with deteriorative changes in fats and oils.
4. Analyzing physico-chemical properties of fats and oils.
5. Creating awareness about nutritional importance of oils and fats.

UNIT-I (14 Hrs.)

Introduction to oils and fats, Physical and chemical properties of fats and oils, Nutritional importance of oils and fats.

UNIT-II (16 Hrs.)

Source and physico-chemical properties of following oils:
Animal – Butter oil, lard and tallow.
Plant – Groundnut, Sunflower, Soybean and Coconut oil. Extraction of oils/fats.
Problems during storage – rancidity, reversion.

UNIT-III (15 Hrs.)

Refining: degumming, choice of alkali, batch and continuous refining.
Bleaching: choice of adsorbent, batch and continuous bleaching.
Deodorization: process parameters: batch and continuous processing

UNIT-IV (15 Hrs.)

Hydrogenation of oils: mechanism, process parameters and batch processing. Fractionation and winterization of oils.
Alternative processing methods: PCT (physical cleaning techniques)

Recommended Books:

1. Meyer L.H., 'Food Chemistry', CBS Publisher, New Delhi,2006.
2. Potter N. N. 'Food Science', 5th Edition, CBS Publisher, New Delhi, 2006
3. Lawson H., 'Food Oils & Fats: Technology, Utilization and Nutrition', CBS Publisher, New Delhi,1995.

TECHNOLOGY OF OILS AND FATS LAB XV

Subject Code: BFOTD1-514 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives:

1. To familiarize students with physico-chemical properties of fats and oils.
2. To impart knowledge regarding various quality indices of fats and oils.
3. To understand organoleptic properties of fats and oils for their appropriate use in food products.
4. To analyze extent of rancidity in fats and oils using appropriate tests.
5. To create awareness regarding adulteration of fats and oils and detection techniques.

Course Outcomes:

1. Familiarizing students with physico-chemical properties of fats and oils.
2. Imparting knowledge regarding various quality indices of fats and oils.
3. Understanding organoleptic properties of fats and oils for their appropriate use in food products.
4. Analyzing the extent of rancidity in fats and oils using appropriate tests.
5. Creating awareness regarding adulteration of fats and oils and detection techniques.

PRACTICAL

1. To determine moisture content of oilseed.
2. To determine FFA of oil.
3. Determination of Iodine Value, R.M. Value and Polenske Value.
4. To determine Saponification value, anisidine value and peroxide value of oil.
5. Determination of melting point of fats.
6. Detection of sesame oil in vanaspati by furfural test.
7. Detection of adulteration with mineral oil, Cotton seed oil or Groundnut oil.
8. Organoleptic evaluation of fats and oils.
9. To carry out refining and bleaching of oil in lab.
10. To estimate colour of oil.
11. Visit to vegetable oils industry.

SEMESTER SIXTH

FOOD ENGINEERING

Subject Code: BFOTS1-601 **L T P C** **Duration: 60(Hrs.)**
3 1 0 4

Course Objectives:

1. To familiarize the students with fundamental concepts and terminology of food engineering.
2. To understand the basic principles, processes and components of material and energy balances.
3. To impart knowledge regarding principles of fluid flow, types of fluids, and equations involved.
4. To develop an ability for an appropriate selection of pump for different types of fluids.
5. To interpret data using psychrometry and utilize this information for developing appropriate storage and processing conditions for different products.

Course Outcomes:

1. Familiarizing the students with fundamental concepts and terminology of food engineering.
2. Understanding the basic principles, processes and components of material and energy balances.
3. Imparting knowledge regarding principles of fluid flow, types of fluids, and equations involved.
4. Developing an ability for an appropriate selection of pump for different types of fluids.
5. Interpretation of data using psychrometry and utilizing this information for developing appropriate storage and processing conditions for different products.

UNIT I (15 Hrs.)

Fundamental Concepts and Definitions: Dimensions and units, thermodynamic systems (closed, open and isolated), intensive and extensive properties, equilibrium state, density, specific volume, specific weight, specific heat, enthalpy, entropy, pressure, temperature scales.

UNIT II (15 Hrs.)

Material Balances: Basic principles, process flow diagrams, total mass balance, component mass balance.
Energy Balances: Basic principles, energy terms, specific heat of solids and liquids, properties of saturated and superheated steam, heatbalances.

UNIT III (15 Hrs.)

Fluid Flow Principles: Fluid statics and dynamics, mass balance and energy balance, Bernoulli's equation, concept of viscosity, Newtonian and non-Newtonian fluids, streamline and turbulent flow, Reynold's number, Selection of pumps

UNIT IV (15 Hrs.)

Psychrometrics: Properties of dry air: composition of air, specific heat of dry air, enthalpy of dry air, dry bulb temperature, Wet bulb temperature, Relative humidity, Dew point temperature.

Recommended Readings:

1. Rao C.G., 'Essentials of Food Process Engineering'. B S publications,2006
2. Rao D.G., 'Fundamentals of Food Engineering', PHI learning private Ltd.,2010.
3. Singh R.P. and Heldman D.R., Introduction to Food Engineering, 2nd, 3rd and 4th Edition, Academic press, 1993, 2003,2009.
4. Fellow P., Food Processing Technology,1988.

FOOD AND NUTRITION

Subject Code: BFOTS1-602 | **L T P C 3 1 0 4** | **Duration: 60(Hrs.)**

Course Objectives:

1. To understand the concept, terminology, and importance of food and nutrition.
2. To familiarize students with different methods of cooking, their effects on properties of foods, merits and demerits.
3. To impart knowledge regarding global trends, nutritional labeling, codex-, and FSSAI guidelines.
4. To develop an ability to plan meals addressing specific needs of society.
5. To create awareness regarding micro-, and macro nutrients present in food in terms of their sources, role, RDA and deficiency.

Course Outcomes:

1. Understanding the concept, terminology, and importance of food and nutrition.
2. Familiarizing the students with different methods of cooking, their effects on properties of foods, merits and demerits.
3. Imparting knowledge regarding global trends, nutritional labeling, codex-, and FSSAI guidelines.
4. Developing an ability to plan meals addressing specific needs of society.
5. Creating awareness regarding micro-, and macro nutrients present in food in terms of their sources, role, RDA and deficiency.

UNIT I (15 Hrs.)

Introduction to food and nutrition: Basic terms used in study of food and nutrition, BMI and nutritional status, understanding relationship between food, nutrition and health. Balanced diet Functions of food-physiological, psychological and social, concept of balanced diet, Food Groups, Food Pyramid.

UNIT II (16 Hrs.)

Nutrients: Classification, digestion, functions, dietary sources, RDA, clinical manifestations of deficiency and excess and factors affecting absorption of the following in brief: Energy, Carbohydrates, lipids and proteins, Fat soluble vitamins-A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, vitamin B12 and vitamin C. Minerals – calcium, iron, iodine, fluorine, copper and zinc

UNIT III (14Hrs.)

Concepts of Meal planning: Factors affecting meal planning, understanding specific considerations for planning meal for different groups of people (Infants, Toddler, Adolescents, Adults, Old age and pregnant women)

UNIT IV (15 Hrs.)

Methods of cooking: Dry, moist, frying and microwave cooking, Advantages, disadvantages and the effect of various methods of cooking on foods. Nutritional labeling. Importance, global trends, codex guidelines, nutritional labelling in India, FSSAI guidelines.

Recommended Readings

1. Bamji M.S., Krishnaswamy K. and Brahmam G.N.V., 'Textbook of Human Nutrition', 3rd Edition, Oxford and IBH Publishing Co. Pvt. Ltd.,2009.
2. Srilakshmi 'Food Science', 4th Edition, New Age International Ltd.,2007.
3. Srilakshmi, 'Dietetics', Revised 5th Edition. New Age International Ltd.,2005.
4. Wardlaw M.G. and Paul M Insel Mosby, 'Perspectives in Nutrition', 3rd Edition,1996.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2_1985) (Rev.1_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation,1993.
6. Food Safety and Standards Authority of India portal, Government ofIndia
7. Gopalan C., 'Nutritive Value of Indian Foods', NIN, ICMR,1990.
8. Seth V. and Singh K., 'Diet planning through the Life Cycle: Part 1. Normal Nutrition.A
9. Practical Manual., 4th Edition, Elite Publishing House Pvt. Ltd.,2005.

SENSORY EVALUATION OF FOOD

Subject Code: BFOTD1-611 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives:

1. To understand the structure and physiology of taste organs, and mechanism of taste perception.
2. To impart knowledge regarding sensory evaluation of different quality attributes of foods and their significance.
3. To familiarize students with taste-, olfactory-, and color abnormalities.
4. To analyze taste, odor, color, and texture of food products using different techniques.
5. To summarize different types of equipments involved in evaluation of sensory attributes of food products.

Course Outcomes:

1. Understanding the structure and physiology of taste organs, and mechanism of taste perception.
2. Imparting knowledge regarding sensory evaluation of different quality attributes of foods and their significance.
3. Familiarizing students with taste-, olfactory-, and color abnormalities.
4. Analyzing taste, odor, color, and texture of food products using different techniques.
5. Summarizing different types of equipments involved in evaluation of sensory attributes of food products.

UNIT I (16 Hrs.)

Taste: Introduction and importance of taste, Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands, Mechanism of taste perception. Chemical dimensions of basic tastes: sweet, salt, sour, bitter and umami. Factors affecting taste quality, reaction time, taste modification, absolute and recognition of threshold taste abnormalities. Taste measurement

UNIT II (15 Hrs.)

Odour: Introduction, definition and importance of odour and flavor, Anatomy of nose, physiology of odour perception, Mechanism of odour perception, Odour classification, chemical specificity of odour. Odour measurement using different techniques – primitive to recent techniques. Merits and demerits of each method. Olfactory abnormalities.

UNIT III (16 Hrs.)

Colour: Introduction and importance of colour. Dimensions of colour and attributes of colour, appearance factors, gloss etc. Perception of colour, Colour abnormalities Measurement of colour; Munsell colour system, CIE colour system, Hunter colour system, spectrophotometry and colorimetry etc.

UNIT IV (13 Hrs.)

Texture: Introduction, definition and importance of texture Phases of oral processing
Texture perception, receptors involved in texture perception Texture classification
Texture measurement – basic rheological models, forces involved in texture measurement.

Recommended Readings

1. Rao E. S., 'Food Quality Evaluation', Variety Books, 2013.
2. Amerine P. and Roessler, 'Principles of Sensory Evaluation of Food', Academic Press, London, 1965.
3. Meilgard D., 'Sensory Evaluation Techniques', 3rd Edition. CRC Press LLC,1999.
4. Man J., 'Principles of Food Chemistry', 3rd Edition., Springer,2007.
5. Brannen and et al., 'Food Additives', Marcel Dekker, New York,1990.

SENSORY EVALUATION OF FOOD LAB XVI

Subject Code: BFOTD1-612 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives:

1. To impart knowledge regarding training of sensory panel.
2. To perform different analytical tests for sensory evaluation of food.
3. To measure quality attributes of various food products.
4. To create awareness regarding sensory attributes of food products and their importance.
5. To evaluate different quality parameters of food products using instruments.

Course Outcomes:

1. Imparting knowledge regarding training of sensory panel.
2. Performing different analytical tests for sensory evaluation of food.
3. Measuring quality attributes of various food products.
4. Creating awareness regarding sensory attributes of food products and their importance.
5. Evaluation of different quality parameters of food products using instruments.

PRACTICAL

1. Training of sensory panel.
2. To perform recognition and sensitivity tests for four basic tastes.
3. To perform analytical tests of sensory evaluation.
4. Recognition tests for various food flavors, flavor defects in milk.
5. Sensory evaluation of milk and milk products.
6. Texture evaluation of various food samples- crispier/ cookies/ biscuits/ snack foods
7. Measurement of colour by using Tintometer/ Hunter Color Labetc.
8. Qualitative tests for hydrogenated fats, butter, ghee
9. Platform tests for milk
10. Quality evaluation of various food stuffs- cereals, pulses, honey, jaggery, sugar, tea, coffee etc.

Recommended Readings

1. Rao E. S., ‘Food Quality Evaluation’, Variety Books, 2013.
2. Amerine P. and Roessler, ‘Principles of Sensory Evaluation of Food’, Academic Press, London, 1965.
3. Meilgard ‘Sensory Evaluation Techniques’, 3rd Edition. CRC Press LLC,1999.
4. deMan J., ‘Principles of Food Chemistry’, 3rd Edition., Springer,2007.
5. Brannen and et al., ‘Food Additives’, Marcel Dekker, New York,1990.

FOOD PLANT LAYOUT

Subject Code: BFOTD1-613 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives:

1. To understand the concept of layout designing and its importance.
2. To impart knowledge regarding factors to be considered for selection of site for setting up a plant.
3. To familiarize the students with considerations for selection of material, process, and machinery.
4. To summarize the importance of management in setting up a plant.
5. To create awareness regarding layout symbols.

Course Outcomes:

1. Understanding the concept of layout designing and its importance.
2. Imparting knowledge regarding factors to be considered for selection of site for setting up a plant.
3. Familiarizing the students with considerations for selection of material, process, and machinery.
4. Summarizing the importance of management in setting up a plant.
5. Creating awareness regarding layout symbols.

UNIT-I (15 Hrs.)

Plant design concepts and general design considerations Plant Layout problems, Importance and Objectives Advantages of a good layout

UNIT-II (15 Hrs.)

Plant location: location factors and their interaction with plant location, Importance of a plant layout selection of site and layouts of different food industries.

UNIT-III (15 Hrs.)

Selection of building material, selection and planning of manufacturing process and service facilities. Process selection; process flow charts, selection of equipment and machinery; maintenance and replacement, depreciation of machinery

UNIT IV (15 Hrs.)

Management set up in a plant. Plant layout, layout symbols.

Recommended Books:

1. Marriott, 'Principle of Food Sanitation', 5th Edition, CBS Publishers, New Delhi,2006.
2. Green J.H. and Kramer A.,'Food Processing Waste Management', AVI Publishers,USA.,1979.
3. Potter N. N., 'Food Science', 5th Edition., CBS Publishers, New Delhi,2006.
4. Sharma S.C., 'Plant Layout and Material Handling',3rd Edition Khanna Publishers,2000.
5. James M. M., 'Plant layout & design',Collier Macmillan Ltd.,1962

FOOD PLANT LAYOUT LAB XVII

Subject Code: BFOTD1-614 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives:

1. To impart knowledge regarding preparation of process diagrams for different food products.
2. To familiarize students with calculation of cost in relation to designing, processing, and depreciation.
3. To understand the factors to be considered while designing the layout and process diagrams of different manufacturing units.
4. To develop an ability to prepare layout for manufacturing plants of different food products.
5. To create awareness regarding depreciation of machinery and processing.

Course Outcomes:

1. Imparting knowledge regarding preparation of process diagrams for different food products.
2. Familiarizing students with calculation of cost in relation to designing, processing, and depreciation.
3. Understanding the factors to be considered while designing the layout and process diagrams of different manufacturing units.
4. Developing an ability to prepare layout for manufacturing plants of different food products.
5. Creating awareness regarding depreciation of machinery and processing.

PRACTICAL

1. Preparation of layout and process diagram of potato crisp manufacturing plant.
2. Preparation of layout and process diagram of Jam/Marmalade manufacturingplant.
3. Preparation of layout and process diagram of Bread makingplant.
4. Preparation of layout and process diagram of a dairy industry.
5. Preparation of layout and process diagram of wine makingunit.
6. Preparation of layout and process diagram of a modern slaughter house.
7. Preparation of layout and process of diagram of a confectionaryunit.
8. Calculation of depreciation of machinery and processingcosts.

FOOD SAFETY

Subject Code: BFOTD1-621 **L T P C 4 0 0 4** **Duration: 60(Hrs.)**

Course Objectives:

1. To understand the concept of food safety, factors involved, and its importance.
2. To impart knowledge regarding importance of hygiene and sanitation in food service establishments and ways to ensure the same.
3. To familiarize students with Indian food regulatory regime and Global Scenario.
4. To develop an ability of hazard management and ensuring food safety.
5. To create awareness regarding emerging pathogens, and recent advancements in food production, processing, and safety.

Course Outcomes:

1. Understanding the concept of food safety, factors involved, and its importance.
2. Imparting knowledge regarding importance of hygiene and sanitation in food service establishments and ways to ensure the same.
3. Familiarizing students with Indian food regulatory regime and Global Scenario.
4. Developing an ability of hazard management and ensuring food safety.
5. Creating awareness regarding emerging pathogens, and recent advancements in food production, processing, and safety.

UNIT I (15 Hrs.)

Introduction to Food Safety: Definition, Types of hazards, biological, chemical, physical hazards, Factors affecting Food Safety, Importance of Safe Foods.

Food Hazards of Physical and Chemical and Microbiological origin, Management of hazards, Need, Control of parameters, Temperature control and Food storage.

UNIT II (14 Hrs.)

Hygiene and Sanitation in Food Service Establishments, Introduction, Sources of contamination, Control methods using physical and chemical agents, Waste Disposal, Pest and Rodent Control and Personnel Hygiene, Food laws and Standards

UNIT III (16 Hrs.)

Indian Food Regulatory Regime, Global Scenario and Other laws and standards related to food safety (FSSAI, AGMARK, FPO, MFPO, MPO, BIS AND ISO)

UNIT IV (15 Hrs.)

Recent concerns: New and Emerging Pathogens, Genetically modified foods\Transgenics, Organic foods and newer approaches to food safety

Recommended Readings

1. Lawley R., Curtis L. and Davis J., ‘The Food Safety Hazard Guidebook’, RSC publishing, 2004.
2. De Vries, ‘Food Safety and Toxicity’, CRC, New York,1997’
3. Marriott, N. G., ‘Principles of Food Sanitation’, AVI, New York,1985.
4. Forsythe, S. J., ‘Microbiology of Safe Food’, Blackwell Science, Oxford,2000.
5. Forsythe S. J., ‘The Microbiology of Safe Food’, 2nd Edition, Willey- Blackwell, U.K., 2010.
6. Mortimore S. and Wallace C. ‘HACCP, A practical approach’, Chapman and Hill, London,1995.
7. Clive de Blackburnand Peter McClure., Foodborne Pathogens Woodhead Publishing, 2009.

FOOD SAFETY LAB XVIII

Subject Code: BFOTD1-622 | **L T P C 0 0 4 2** | **Duration: 60(Hrs.)**

Course Objectives:

1. To familiarize students with different types of media preparations used in microbiology.
2. To identify type of microbes present using different microbiological techniques.
3. To impart knowledge regarding microbiological contamination of water and its analysis.
4. To develop an ability for microbiological examination of food samples and interpretation of data.
5. To create awareness regarding types of hazards, importance of hygiene and sanitation and ways for their assessment.

Course Outcomes:

1. Familiarizing students with different types of media preparations used in microbiology.
2. Identifying type of microbes present using different microbiological techniques.
3. Imparting knowledge regarding microbiological contamination of water and its analysis.
4. Developing an ability for microbiological examination of food samples and interpretation of data.
5. Creating awareness regarding types of hazards, importance of hygiene and sanitation and ways for their assessment.

PRACTICAL

1. Preparation of different types of media (complex, differential and selective)
2. Enumeration of aerial microflora using PDA
3. Identification of Molds by lactophenol bluestaining
4. Negative Staining
5. Microbiological Examination of food
6. Bacteriological Analysis of Water by MPN method
7. Assessment of surface sanitation by swab and rinse method
8. Assessment of personal hygiene
9. Detection of Physical and chemical hazards in food.
10. Determination of coliforms in water.

Recommended Readings

1. Lawley R., Curtis L. and Davis J., 'The Food Safety Hazard Guidebook', RSC publishing, 2004.
2. De Vries, 'Food Safety and Toxicity', CRC, New York,1997.
3. Marriott, N. G., 'Principles of Food Sanitation', AVI, New York,1985.
4. Forsythe, S. J., 'Microbiology of Safe Food', Blackwell Science, Oxford,2000.
5. Forsythe S. J., 'The Microbiology of Safe Food', 2nd Edition, Willey- Blackwell, U.K., 2010.
6. Mortimore S. and Wallace C. 'HACCP, A practical approach', Chapman and Hill, London,1995.
7. Clive de Blackburnand Peter McClure., Foodborne Pathogens Woodhead Publishing, 2009.

FOOD QUALITY MANAGEMENT

Subject Code: BFOTD1-623 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives:

1. To understand the concept of quality and its importance in agri-food production chain.
2. To familiarize students with quality management systems in India and their role in quality control and assurance.
3. To impart knowledge regarding different types of ingredients and processing techniques involved in food production.
4. To analyze chemical, technological and toxicological aspects of different types of food additives used in food industry.
5. To create awareness regarding contamination of food, its sources and control.

Course Outcomes:

1. Understanding the concept of quality and its importance in agri-food production chain.
2. Familiarize the students with quality management systems in India and their role in quality control and assurance.
3. Imparting knowledge regarding different types of ingredients and processing techniques involved in food production.
4. Analyzing chemical, technological and toxicological aspects of different types of food additives used in food industry.
5. Creating awareness regarding contamination of food, its sources and control.

UNIT I (15 Hrs.)

Introduction to food quality management – Definition of quality, quality concepts, quality perception, quality attributes.
Concepts of quality management: Objectives, importance and functions of quality control and quality assurance; Quality management systems in India

Quality in the Agri- food production chain-Techno- managerial approach, food quality relationship and food quality management functions. Dynamics on the agri- food production chain, core developments in food quality management.

UNIT II (15 Hrs.)

Contamination in Food: Physical, chemical contaminants (heavy metals, pesticide residues, antibiotics, agrochemicals, veterinary drug residues, environmental pollutants, radio-nucleides, solvent residues, chemicals) and Natural toxins.

UNIT III (15 Hrs.)

Chemical, technological and toxicological aspects
Risk assessment studies: Safety and quality evaluation of additives and contaminants, Acute and chronic studies. Introduction, need of food additives in food processing and preservation, Characteristics and classification of food additives.
Antimicrobial agents. -Nitrites, sulphides, sulphur dioxide, sodium chloride, hydrogen peroxide.

UNIT IV (15 Hrs.)

High fructose corn syrup, cryogenic freezing, supercritical fluid extraction, fat mimetics, flavour encapsulation, use of nano technology in foods etc.

Recommended Readings

1. Pieternel A, L. and Willem J. M., 'Food Quality Management Technological and Managerial principles and practices', Wageningen,2009.
2. Brannen and et al., 'Food Additives', Marcel Dekker, New York,1990.
3. Jones J. M., 'Food Safety', Eagan Press,1992.
4. Shapton D.A. and Shapton N.F., 'Principles and Practices for the safe processing of Foods' CRC Press,1998.
5. DeMan, 'Principles of Food Chemistry', 3rd edition, Springer,2007.

FOOD QUALITY MANAGEMENT LAB XIX

Subject Code: BFOTD1-624 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives:

1. To familiarize students with qualitative estimation of different food components in various food stuffs.
2. To conduct quality inspection of different food stuffs.
3. To analyze different food components quantitatively.
4. To implement GMP and HACCP in food industry.
5. To evaluate different food contaminants in food stuffs.

Course Outcomes:

1. Familiarizing students with qualitative estimation of different food components in various food stuffs.
2. Conducting quality inspection of different food stuffs.
3. Analyzing different food components quantitatively.
4. Implementing GMP and HACCP in food industry.
5. Evaluating different food contaminants in food stuffs.

PRACTICAL

1. Qualitative tests for hydrogenated fats, butter, and ghee.
2. Quality inspection of various food stuffs- cereals, pulses, spices and condimentsetc.
3. Estimation of sulphur dioxide in foods
4. Chromatographic estimation of colour.
5. Analysis of edible common salt for moisture content, MIW and totalchlorides.
6. Estimation of ammonia nitrogen inwater.
7. Estimation of benzoic acid/ sorbic acid in foods.
8. To implement HACCP plan in particular phases of food chain.
9. To evaluate various processes in food plant for implementation of GMP.
10. Determination of insecticides in given food samples.
11. Determination of heavy metals in food samples.

Recommended Readings

1. Pieternel A, L. and Willem J. M., ‘Food Quality Management Technological and Managerial principles and practices’, Wageningen,2009.
2. Brannen and et al., ‘Food Additives’, Marcel Dekker, NewYork,1990.
3. Jones J. M., ‘Food Safety’, Eagan Press,1992.
4. Shapton D.A. and Shapton N.F., ‘Principles and Practices for the safe processing of Foods’ CRC Press,1998.
5. DeMan, ‘ssPrinciples of Food Chemistry’, 3rd edition, Springer, 2007

SEMESTER SEVENTH

FOOD STORAGE ENGINEERING

Subject Code: BFOTS1-701 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives

1. To familiarize students with the importance of scientific storage systems.
2. To understand various post-harvest changes and causes of spoilage in fruits and grains.
3. To provide the knowledge about various storage structures.
4. To create awareness regarding prevention methods to protect fruits and grains from insects and pests.
5. To understand the design of storage structures and various specifications for designs of storage systems.

Course Outcomes

1. Familiarize students with the importance of scientific storage systems.
2. Understanding various post-harvest changes and causes of spoilage in fruits and grains.
3. Providing knowledge about various storage structures.
4. Creating awareness amongst students about prevention of fruits and grains from insects and pests.
5. Understanding the design of storage structures and various specifications for designs of storage systems.

UNIT I (12 Hrs.)

Introduction: Importance of scientific storage systems, post-harvest physiology of semi- perishables and perishables, climacteric and non-climacteric fruits, respiration, ripening, changes during ripening, ethylene bio-synthesis. Damages Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control

UNIT II (17 Hrs.)

Storage structures: Traditional storage structures, improved storage structures, modern storage structures, godown layout, staking pattern and rodent proof godown design; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos. Storage of grains Respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation. Aeration and stored grain management Purposes of aeration, aeration theory, aeration system design, aeration system operation

UNIT III (16 Hrs.)

Damage due to insects and pests during storage and its control, seed coating, fumigations, etc.; Damage caused by rodents and its control. Storage of perishables cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage

UNIT IV (15 Hrs.)

Design of storage structures Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos, BIS specifications, functional, structural and thermal design of cold stores

Recommended Readings:

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, The Netherlands.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer ScienceBusiness Media, New York, USA. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.
4. Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh. 1997. Handbook of Food Engineering Practice. CRC Press, Boca Raton, FL, USA.
5. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2 nd Ed. Elsevier Science Ltd., Burlington, MA, USA.
6. J.F. Richarson and D.G. Peacock. 1994. Coulson &Richardsons's Chemical Engineering, Vol. 3, Chemical &Biochemical Reactors & Process Control, 3rd Ed. Elsevier Butterworth-Heinemann, Amsterdam, The Netherlands.
7. James R. Couper, W. Roy Penney, James R. Fair and Stanley M. Walas 2012 Chemical Process Equipment: Selection and Design. Elsevier Inc
8. Mahajani, V. V. and Umarji, S. B., Process equipment design, Macmillan.
9. Bhattacharyya, B. C., Introduction to Chemical Equipment design, CBS Publishers and Distributors.
10. Geankoplis C. J. Transport processes and unit operations, Prentice-Hall

FOOD BIOTECHNOLOGY

Subject Code: BFOTS1-702 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives

1. To impart knowledge about basics of food biotechnology.
2. To create the awareness about different toxins and various naturals antimicrobial agents used in food preservation.
3. To remember the concept of genetic engineering and its role in food production enhancement.
4. To understand the methods and applications of protein engineering in food technology.
5. To analyze the role of Intellectual property rights (IPR) in biotechnology and their associated benefits.

Course Outcomes

1. Imparting knowledge about basics of food biotechnology.
2. Creating the awareness about different toxins and various naturals antimicrobial agents used in food preservation.
3. Remembering the concept of genetic engineering and its role in food production enhancement.
4. Understanding the methods and applications of protein engineering in food technology.
5. Analyzing the role of Intellectual property rights (IPR) in biotechnology and their associated benefits.

UNIT I(15 Hrs.)

Introduction to food biotechnology: basic principles of genetic engineering, improvement of the processing of various crops by genetic engineering, food safety.

UNIT II(16 Hrs.)

Natural antimicrobials for food preservation: Phytoalexins, essential oils and their components, bacteriocins of Lactic acid bacteria, nisin, pediocinsetc, applications of bacteriocins in food systems. Aflatoxins-production, control and reduction using molecular strategy.

UNIT III(14 Hrs.)

Protein engineering in food technology: Methods and applications of protein engineering (e.g. glucoseisomerase, Lactobacillusbeta-galactosidase and peptideantibioticnisin). Biotechnology and Food ingredients: biogums,fatsubstitutes, biocolors, organicacids and sweetners.

UNIT IV(15 Hrs.)

Food Bio-technology and Intellectual property rights (IPR), benefits of securing IPRs; bioethics in food biotechnology. Transgenic plants and animals: Their contribution to food production enhancement.

Recommended Readings:

1. B.H.Lee,‘Fundamentals ofFood Biotechnology’,VCHPublishers,NewYork,U.S.A.
2. M.P.Tombs,‘BiotechnologyinFoodIndustry’,Wiley-Blackwell,U.K.
3. D.Knorr,‘Food Biotechnology’,MarcelDekker, INC,NewYork,U.S.A.
4. A.Schwartzberg and A Rao ‘Biotechnology & Food Process Engineering’ Marcel Dekker,INC,New York.
5. I.Goldberg and R. Williams, ‘Biotechnology and Food Ingredients’, Springer Science &BusinessMedia, Germany.
6. R.D.KingandP.S.J.Cheetham,‘FoodBiotechnology’,ElsevierAppliedScience,London.

TECHNOLOGY OF BEVERAGES

Subject Code: BFOTS1-703 **L T P C** **Duration: 60(Hrs.)**
4 0 0 4

Course Objectives

1. To impart the knowledge of types and importance of beverages.
2. To understand the technology behind processing of different beverages to meet the legal specifications.
3. To familiarize with the concept of water treatment along with quality parameters involved.
4. To use different types of additives to address the specified needs of consumers.
5. To create awareness regarding quality control tests used in beverages.

Course Outcomes

1. Imparting the knowledge of types and importance of beverages.
2. Understanding the technology behind processing of different beverages to meet the legal specifications.
3. Familiarize with the concept of water treatment along with quality parameters involved.
4. Application of different types of additives to address the specified needs of consumers.
5. Creating awareness regarding quality control tests used in beverages.

UNIT-I (15 Hrs.)

History and importance of beverages and status of beverage industry, Processing of beverages: Packaged drinking water, juice-based beverages, synthetic beverages, still, carbonated, Low-calorie and dry beverages, isotonic and sports drinks Dairy based beverages Alcoholic beverages, fruit beverages, specialty beverages.

UNIT-II (15 Hrs.)

Tea, coffee, cocoa, plant extracts, etc. FSSAI specifications for beverages, Ingredients, manufacturing and packaging processes and equipment for different beverages, Water treatment and quality of process water.

UNIT III (15 Hrs.)

Sweeteners, colorants, acidulants, Clouding and clarifying and flavouring agents for beverages. Use of carbon dioxide in carbonation.

UNIT-IV (15 Hrs.)

Quality tests and control in beverages. Miscellaneous beverages: Coconut water, sweet toddy Sugar cane juice, coconut beverage, flavoured syrups.

Recommended Readings:

1. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets.Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
2. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
4. AmalenduChakraverty, Arun S. Mujumdar, G.S. VijayaRaghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.

SNACKS AND EXTRUSION TECHNOLOGY

Subject Code: BFOTS1-704	**L T P C**	**Duration: 60 (Hrs.)**
	4 0 0 4	

Course Objectives

1. To acquire knowledge about compositions, formulations and quality testing of Snack foods.
2. To make students aware about specifications, compositions, ingredients, processing techniques of
3. breakfast cereals and texturized vegetable protein
4. To familiarize with different types of extruders.
5. To learn about manufacturing of different extruded products.
6. To get knowledge about Chemical and nutritional changes in food during extrusion.

Course Outcomes

1. Imparting knowledge about compositions, formulations and quality testing of Snack foods.
2. Creating awareness aware about specifications, composition, ingredients, processing techniques of breakfast cereals and texturized vegetable protein
3. Familiarizing with different types of extruders.
4. Understanding manufacturing of different extruded products.
5. Analyzing the chemical and nutritional changes in food during extrusion.

UNIT I (14 Hrs.)

Snack foods: Types, specifications, compositions, ingredients, Formulations, processing, equipment, packaging, storage and quality testing, Snack food seasonings

UNIT II (15 Hrs.)

Classification of Breakfast cereals: Raw materials, process and quality testing of vermicelli, spaghetti: and macronic products Texturized vegetable protein: Definition, processing techniques, and foods Ready to eat breakfast cereals by extrusion cooking. Specifications, compositions, ingredients Formulations, processing Packaging, storage and quality testing for breakfast cereals, macaroni and malts.

UNIT III (15 Hrs.)

Extrusion: definition, introduction to extruders, principles and types, Uses of extruders in the food industry, Single screw extruder: principle of working, factors affecting extrusion process, Twin screw extruder: counter rotating and co-rotating twin screw extruder, Process characteristics of the twin screw extruder

UNIT IV (16 Hrs.)

Pre-conditioning of raw materials used in extrusion process Use of dry extruders in extrusion Chemical and nutritional changes in food during extrusion. Extrusion technology and applications in food processing.

Recommended Readings:

1. NIIR Board of Consultants & Engineers. 2014. The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production), 3rd Ed. NIIR, New Delhi.
2. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. E.J. Pyler and L.A. Gorton. 2009. Baking Science & Technology, Vol. II: Formulation & Production, 4 th Ed. Sosland Publishing Company, Kansas City, MO, USA.
4. E.J. Pyler and L.A. Gorton. 2008. Baking Science & Technology, Vol. I: Fundamentals & Ingredients, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.
5. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
6. John J. Kingslee. 2006. A Professional Text to Bakery and Confectionery. New Age International, New Delhi.
7. Harold Corke, Ingrid De Leyn, Nanna A. Cross, Wai-Kit Nip, Y.H. Hui. 2006. Bakery Products: Science and Technology. Blackwell Publishing Ltd., Oxford, UK.
8. Joseph Amendola and Nicole Rees. 2003. Understanding Baking: The Art and Science of Baking, 3rd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
9. Duncan Manley. 2000. Technology of Biscuits, Crackers and Cookies, 3rd Ed. Woodhead Publishing Limited, Cambridge, England.
10. N.L. Kent and A.D. Evers. 1994. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture, 4th Ed. Elsevier Science Ltd., Oxford, UK.
11. E.B. Jackson. 1995. Sugar Confectionery Manufacture, 2nd Ed. Springer-Verlag, US.
12. B.W. Minife. 1989. Chocolate, Cocoa, and Confectinery – Science and Technology, 3rd Ed. Chapman and Hall, Inc., New York, USA.
13. Samuel A. Matz. 1976. Snack Food Technology, 2nd Ed. AVI Publishing Co., Inc., Westport, Connecticut, USA.

TECHNOLOGY OF BEVERAGES LAB XX

Subject Code: BFOTS1-705 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives

1. To impart knowledge regarding quality analysis of water.
2. To understand the technology behind processing of different types of beverages.
3. To familiarize with the methods involved in determination of different additives used in the formulation of beverages.
4. To analyze different quality parameters of beverages so as to meet the legal specifications.
5. To understand the mode of working in industrial setups as an individual and as a team.

Course Outcomes

1. Imparting knowledge regarding quality analysis of water.
2. Understanding the technology behind processing of different types of beverages.
3. Familiarize with the methods involved in determination of different additives used in the formulation of beverages.
4. Analysis of quality parameters of beverages so as to meet the legal specifications.
5. Understanding the mode of working in industrial setups as an individual and as a team.

PRACTICALS

1.Quality analysis of raw water

2. Determination of brix value, pH and acidity of beverages

3. Determination of density and viscosity of caramel

4. Preparation of synthetic beverage

5. Determination of colours in soft drinks by wool technique

6. Preparation of iced and flavoured tea

7. Preparation of instant tea

8. Assessment of purity of carbon dioxide

9. Preparation of carbonated and non-carbonated beverages

10. Preparation of sports drink

11. Preparation of dairy/ fruit-based beverage

12. Determination of caffeine in beverages

13. Quality analysis of tea and coffee

14. Preparation of miscellaneous beverages

15. Visit to carbonation unit

16. Visit to mineral water plant

SNACKS AND EXTRUSION TECHNOLOGY LAB XXI

Subject Code: BFOTS1-706 **L T P C** **Duration: 60(Hrs.)**
0 0 4 2

Course Objectives

1. To learn about identifications and composition of various ingredients used for manufacturing of snacks and extruded products.
2. To gain knowledge about testing of different raw materials used in preparation of snacks and extruded products.
3. To learn about manufacturing of different snack food products and extruded products.
4. To become familiarize with different tests to quality evaluation of extruded products.
5. To become aware about packaging of snack food products and extruded products.

Course Outcomes

1. Understanding of identifications and composition of various ingredients used for manufacturing of snacks and extruded products.
2. Imparting knowledge about testing of different raw materials used in preparation of snacks and extruded products.
3. Development of different snack food products and extruded products.
4. Familiarizing with different tests to quality evaluation of extruded products.
5. Creating awareness about packaging of snack food products and extruded products.

PRACTICALS

1. Identification and composition of various ingredients used for preparation of snacks
2. Flours, their classifications and characterization
3. Determination of flour gluten
4. Determination of water absorption characteristics and dough development time
5. Determination of dough rising capacity
6. Determination of calcium carbonate in fortified atta
7. Quality evaluation of selected snack items
8. Preparation of pasta
9. Preparation of macroni
10. Preparation of vermicelli
11. Preparation of noodles
12. Preparation of selected extruded products
13. Packaging and quality evaluation of extruded products
14. Visit to snack industry

Maharaja Ranjit Singh Punjab Technical University
Bathinda-151001

FACULTY OF SCIENCES

SYLLABUS

FOR

M.Sc. (FOOD SCIENCE AND TECHNOLOGY)

2021 BATCH ONWARDS

(ii) Subject to change in the syllabi at any time.

Please visit the University website time to time.

Semester 1st		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MFOT1-101	Principles of Food Preservation	4	0	0	40	60	100	4
MFOT1-102	Basic Food Microbiology	4	0	0	40	60	100	4
MFOT1-103	Food Chemistry	4	0	0	40	60	100	4
MFOT1-104	Food Analysis and Instrumentation Lab.-I	0	0	4	60	40	100	2
MFOT1-106	Food Microbiology Lab.-II	0	0	4	60	40	100	2
Departmental Elective –I (Select any one)		4	0	0	40	60	100	4
MFOT1-158	Nutraceutical and Functional Foods							
MFOT1-157	Nutrition and Health							
Open Elective –I (Select any one)		3	0	0	40	60	100	3
Total		19	0	8	320	380	700	23

*Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.
**Open Elective: Student must choose open elective subject offered by other departments.

Semester 2nd		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MFOT1-206	Basic Food Engineering	4	0	0	40	60	100	4
MFOT1-207	Technology of Cereals and Millets	4	0	0	40	60	100	4
MFOT1-208	Computer Fundamentals and Statistics	4	0	0	40	60	100	4
MFOT1-209	Technology of Cereals and Millets Lab.-III	0	0	4	60	40	100	2
Departmental Elective –II (Select any one)		4	0	0	40	60	100	4
MFOT1-258	Technology of Beverages							
MFOT1-259	Technology of Malting and Brewing							
Departmental Elective –III (Select any one)		4	0	0	40	60	100	4
MFOT1-260	Food Biotechnology							
MFOT1-261	Food Additives							
	Total	20	0	4	260	340	600	22

*Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.
After 2nd Semester the students will undertake an In-plant summer training of six weeks in industry/organization. The evaluation of training will be done in the fourth semester.

Semester 3rd		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MFOT1-315	Technology of Fruits and Vegetables	4	0	0	40	60	100	4
MFOT1-311	Unit Operations in Food Engineering	4	0	0	40	60	100	4
MFOT1-312	Food Packaging	3	0	0	40	60	100	3
MFOT1-313	Technology of Fruits and Vegetables Lab.- IV	0	0	4	60	40	100	2
MFOT1-314	Food Packaging Lab.-V	0	0	4	60	40	100	2
Departmental Elective –IV (Select any one)*		3	0	0	40	60	100	3
MFOT1-364	Food Standards and Quality Assurance							
MFOT1-363	Technology of Pulses and Oil seeds							
Open Elective –II (Select any one)**		3	0	0	40	60	100	3
MFOT1-420	Dissertation***	0	0	-	-	-	-	2
Total		17	0	8	320	380	700	23

*Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.
**Open Elective: Student must choose open elective subject offered by other departments.
***Thesis will continue in 4th Semester. Students will have to finalize the topic of research and its objectives in 3rd Semester.

Semester 4th		Contact Hrs.			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MFOT1-415	Technology of Egg, Meat, Fish and Poultry	4	0	0	40	60	100	4
MFOT1-416	Technology of Milk and Milk Products	4	0	0	40	60	100	4
MFOT1-417	Food Analysis and Instrumentation	3	0	0	40	60	100	3
MFOT1-418	Technology of Animal Products Lab.-VI	0	0	4	60	40	100	2
MFOT1-419	In Plant Summer Training Viva	0	0	0	60	40	100	1
MFOT1-420	Dissertation	0	0	16	Satisfactory/ Unsatisfactory			8
Total		11	0	20	240	260	500	22

Overall

Semester	**Marks**	**Credits**
1st	700	23
2nd	600	22
3rd	700	23
4th	500	22
Total	2500	90

SEMESTER FIRST

PRINCIPLES OF FOOD PRESERVATION

Subject Code: MFOT1-101 **L T PC 4 0 0 4** **Duration: 60Hrs.**

Course Objectives:

To imparting knowledge on the causes of food spoilage and principles of food preservation.
To understanding the applications of basic and advanced equipments used for food preservation.
To creating the awareness about limits of chemical preservatives safe for human consumption.
To analyzing the effectiveness of novel preservation techniques over traditional methods with respect to food and environment.

Course Outcomes:

Imparting knowledge on the causes of food spoilage and principles of food preservation.
Understanding the applications of basic and advanced equipments used for food preservation.
Creating the awareness about limits of chemical preservatives safe for human consumption.
Analyzing the effectiveness of novel preservation techniques over traditional methods with respect to food and environment.

UNIT-I (15 Hrs.)

Introduction and historical developments of food preservation.
Principles of Food Preservation. Food Spoilage: Microbial, physical, chemical and miscellaneous.
Heat Preservation and Processing: Thermal death curve, canning of foods, canning process, equipment, effect on food, aseptic processing.

UNIT-II (15 Hrs.)

Dehydration: Drying curves, water activity, drying process, types of dryers, dehydration effect in food.
Concentration: Technology of concentration, equipment, process, and changes in food during concentration.
Intermediate Moisture (IM) Foods: Principles, characteristics, advantages, and problems in developing new IM foods.

UNIT-III (16 Hrs.)

Refrigeration Storage: Requirements of refrigeration storage, changes in foods during refrigeration storage.
Freezing and Frozen Storage: Freezing curves, factors determining freezing rate, types of freezers, changes in food during freezing.
Ionizing Radiation: Source; equipment; mechanism of preservation, dose determination, effect on food.
Microwaves: Mechanism of heating, equipment and its effect on food.
Household Preservation Methods: Salt curing, oiling and smoking.
Chemical Preservation: types, uses and effects of class I and class II preservatives in foods.

UNIT-IV (14 Hrs.)

Recent Methods in Food Preservation: Pulse electric, ultrasound, infrared, high pressure, Ohmic heating, hurdle technology, nanotechnology in food processing.

Recommended Books

1. N.P. Norman and H.H. Joseph, 'Food Science', CBS Publishers & Distributors Pvt. Ltd., New Delhi, India.
2. W.C. Frazier and D.C. Westh off, 'Food Microbiology', Tata McGraw Hill Publishing Company Ltd., New Delhi, India.
3. M. Kalia and S. Sangita, 'Food Preservation and Processing', Kalyani Publishers, New Delhi, India.

4. B. Sivasankar,'Food Processing and Preservation', Prentice Hall of India Pvt. Ltd., New Delhi, India.
5. J.N. Desrosier and N.W. Desrosier, 'Technology of Food Preservation', CBS Publishers & Distributors Pvt. Ltd., New Delhi,India.
6. P. Fellows, 'Food Process Technology: Principles and Technology', CRC Press, Cambridge, England.
7. N. Khetarpaul, 'Food Processing and Preservation', Daya Publishing House, NewDelhi,India.

BASIC FOOD MICROBIOLOGY

Subject Code: MFOT1-102 **L T P C** **Duration: 60Hrs.**
4 0 0 4

Course Objectives:
To applying the knowledge of HACCP and food safety to prevent the growth of microbes in foods.
To detection of food borne pathogens using novel techniques of analysis.
To evaluating the factors encouraging and restricting the growth of microbes in foods.
To analyzing the role of pathogens in food borne illnesses.

Course Outcomes:
Applying the knowledge of HACCP and food safety to prevent the growth of microbes in foods.
Detection of food borne pathogens using novel techniques of analysis.
Evaluating the factors encouraging and restricting the growth of microbes in foods.
Analyzing the role of pathogens in food borne illnesses.

UNIT-I (15 Hrs.)

Microbiology: Introduction, historical developments in food microbiology; prokaryotes and eukaryotes; classification of microorganisms- a brief account; sources of microorganisms in foods; microbial growth, growth curve; factors affecting growth-intrinsic and extrinsic factors controlling growth of microorganisms, microbiological criteria of foods and their significance.

UNIT-II (15 Hrs.)

Effect of food preservatives, heating process, irradiation, low temperature storage, chemical preservatives, high-pressure processing; water activity and hurdle technology on microbial growth.

UNIT-III (16 Hrs.)

Foods Microbiology and Public Health: Food poisoning, types of food poisonings, important features etc; bacterial agents of food borne illness, food poisoning by *clostridium, salmonella, E. coli, bacillus, staphylococcus* etc.; non-bacterial agents of food borne illness: poisonous algae, and fungi - a brief account, the HACCP system and food safety used in controlling microbiological hazards.

UNIT-IV (14 Hrs.)

Food spoilage and microbes of milk, meats, fish, fruits, vegetables and cereals, spoilage of canned foods; Indicators microorganisms, methods of isolation and detection of microorganisms; conventional methods; rapid methods (newer techniques) – immunological methods; fluorescent, antibody, radio immunoassay, principles of ELISA, PCR (Polymerized chain reactions).

Recommended Books

1. J.M. Jay, 'Modern Food Microbiology', CBS Publishers, New Delhi, India.
2. G.J. Banwart, 'Basic Food Microbiology', CBS Publishers, New Delhi, India.
3. M.R. Adam and M.O. Moss, 'Food Microbiology', CRC Press, U.S.A.
4. B. Ray, 'Fundamental Food Microbiology', CRC Press, New York, U.S.A.
5. R.Y. Stanier, 'General Microbiology', Palgrave Macmillan, Dunfermline, United Kingdom.

FOOD CHEMISTRY

Subject Code: MFOT1-103 **L T PC 4 0 0 4** **Duration: 60Hrs.**

Course Objectives:

1. To learn about the knowledge of chemical composition of food.
2. To Understanding the harmful effects of allergens and toxic constituents of foods on human health.
3. To analyzing the factors affecting nutritional composition of food.
4. To evaluating the processes leading to desirable and undesirable changes occurring in food.

Course Outcomes:

1. Imparting the knowledge of chemical composition of food.
2. Understanding the harmful effects of allergens and toxic constituents of foods on human health.
3. Analyzing the factors affecting nutritional composition of food.
4. Evaluating the processes leading to desirable and undesirable changes occurring in food.

UNIT-I (16 Hrs.)

Food Chemistry: Definition, scope and importance.

Carbohydrates: classification, physical and chemical properties of sugars, functional properties, and uses of pectic substances, gums and dietary fiber in food; browning reaction in food: enzymatic and non-enzymatic browning, their occurrence and applications in food; starches: functionality of starch in foods, gelatinization and retro-gradation of starches, modified starches, resistant starches.

Vitamins: Water and fat–soluble vitamins, use of vitamins in foods and their properties. Effect of processing on vitamins.

Minerals of Foods: Calcium, phosphorus, iron, copper, lead, zinc and arsenic.

UNIT-II (14 Hrs.)

Proteins: structures of protein and amino acids; physical, chemical and functional properties of proteins, functional properties of food proteins, modification of food protein in processing and storage and its implications, texturized, denaturation of protein, gel formation. Enzymes- sources, properties, role of enzymes in dairy, starch and sugar, juice/beverage, and meat industry.

UNIT-III (14 Hrs.)

Lipids Classification, Properties- lipolysis, auto-oxidation, rancidity and flavor reversion, thermal decomposition and effect of ionizing radiations; modification of fats and oils (hydrogenation and inter-esterification); role of food lipids in flavor; nutritional aspects of natural and modified fats; fat mimetics.

UNIT-IV (16 Hrs.)

Plant Pigments: Chlorophyll, anthocyanins and carotenoids, occurrence, structure, chemistry, functions and changes during processing.

Essential Oils: Occurrence, structure, biosynthesis, extraction of essential oils, uses in foods. Flavoring compounds in foods.

Allergens, toxic constituents and anti-nutritional factors of foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, flatulence causing sugars, phytolectins).

Recommended Books

1. L.H. Meyer, 'Food Chemistry', Van Nostr and, Reinhold Comp Publications , , USA. New York,
2. C. Alias and G. Linden, 'Food Biochemistry', Ellis Horwood, New York,U.S.A.
3. Y. Pomeranz and R. Meloon, 'Food Analysis: Theory and Practice', Westport, An AVI Publication, New York, Sydney, Toronto.
4. R.O. Fennema, 'Food Chemistry', Marcel Dekker, New York, U.S.A.
5. L.H. Meyer, 'Food Chemistry', Van Nostr and, Reinhold Company Publication, New York, U.S.A.

FOOD ANALYSIS AND INSTRUMENTATION LAB - I

Subject Code: MFOT1-104 **L T PC** **Duration: 60Hrs.**
0 0 4 2

Course Objective:

1. To understanding the nutritional composition of food.
2. To application of novel techniques in food analysis.
3. To evaluating the quality parameters of food products to ensure food safety and public health.
4. To analysis of proximate composition of food products.

Course outcome:

1. Understanding the nutritional composition of food.
2. Application of novel techniques in food analysis.
3. Evaluating the quality parameters of food products to ensure food safety and public health.
4. Analysis of proximate composition of food products.

PRACTICAL

1. Analysis of given food sample for its moisture, fat, protein and ash contents.
2. Determination of vitamin C content in a given sample of citrus juice.
3. Estimation of calcium and phosphorus content in a given sample of food.
4. Calculation of iodine value and saponification value of given sample of fat or oil.
5. Estimation of tannins in a given sample of tea.
6. To study the process of Thin Layer Chromatography (TLC) to separate out various components in a given sample.
7. To estimate the amount of reducing sugars in a given food sample.
8. Calculation of smoke point, flash point and fire point of a given sample of vegetable oil.
9. Estimation of caffeine content in a given sample of coffee.
10. Determination of crude fiber content in given sample of vegetable/fruit.
11. Determination of non-reducing sugars, total sugars and starch in fruit sample.
12. Determination of total ash, acid insoluble and soluble ash in a given flour sample.
13. Estimation of rancidity in rancid oil/fat.
14. Detection of adulterants in oil/fat samples.
15. Estimation of Free Fatty Acids (FFA) in crude and refined oil sample.
16. Sensory analysis of various processed food products like jam, bread, and biscuit.
17. Determination of % age moisture, fat and curd content of Table Butter.

FOOD MICROBIOLOGY LAB-II

Subject Code: MFOT1-106 **L T P C** **Duration: 60Hrs.**
0 0 4 2

Course Objectives:

1. To imparting the knowledge of media preparation, staining methods and handling practices
2. To understand about of microbial tools and techniques for detection of spoilage microorganisms.
3. To analyzing the microbial load of different food products to determine their safety for human consumption.
4. To evaluating the growth curve of microbes in relation to its effect on food quality.

Course Outcomes:

1. Imparting the knowledge of media preparation, staining methods and handling practices.
2. Application of microbial tools and techniques for detection of spoilage microorganisms.
3. Analyzing the microbial load of different food products to determine their safety for human consumption.
4. Evaluating the growth curve of microbes in relation to its effect on food quality.

PRACTICALS

1. Study of the different parts and use of laboratory microscope.
2. Preparation and sterilization of culture media, glassware.
3. Estimation of bacterial population in a given sample of food by Direct Microscopic Count (DMC) method.
4. Estimation of bacterial load of food sample by SPC (Standard Plate Count)method.
5. Insolation of pure culture of bacteria by pour plate and streak plate methods.
6. To study simple staining of bacteria.
7. To conduct Gram's staining of bacteria and differentiate between Gram +ve and Gram -ve bacteria.
8. Microbial analysis of cereals and cereal products such as wheat flour and biscuits.
9. Microbial analysis of spices (red chilies and coriander).
10. Detection of presence of *E. coli* and other *Coliform* bacteria in water by MPN and high coliform test.
11. Studies on the bacterial growth curve.
12. Estimation of total microbial count of:
13. Surrounding air
14. Workers
15. Fruit and vegetable products
16. Isolation of bacteria by serial dilution technique.
17. To study various sub-culturing techniques.
18. To study about spawn preparation of mushroom.

NUTRACEUTICAL AND FUNCTIONAL FOODS

Subject Code: MFOT1-158 | **L T P C 4 0 0 4** | **Duration: 60Hrs.**

Course Objectives:

1. To imparting the knowledge of nature, types, and scope of nutraceutical and functional foods.
2. To application of nutraceutical and functional foods for the treatment of various disorders.
3. To creating the ability of effective communication with society regarding therapeutical effects of nutraceutical and functional foods.
4. To evaluating the functionality of nutraceutical compounds with respect to their stability and shelf life.

Course Outcomes:

1. Imparting the knowledge of nature, types, and scope of nutraceutical and functional foods.
2. Application of nutraceutical and functional foods for the treatment of various disorders.
3. Creating the ability of effective communication with society regarding therapeutical effects of nutraceutical and functional foods.
4. Evaluating the functionality of nutraceutical compounds with respect to their stability and shelf life.

UNIT-I (15 Hrs.)

Defining nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods.

Nutraceutical and functional food applications and their health benefits. Nutraceutical compounds and their classification based on chemical and biochemical nature with suitable and relevant descriptions.

UNIT-II (15 Hrs.)

Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension.

Antioxidants and other phytochemicals, (isoflavones, lycopenes), their role as nutraceuticals and functional foods.

Dietary fibers and complex carbohydrates as functional food ingredients.

UNIT-III (15 Hrs.)

Protein as a functional food ingredient. Probiotic foods and their functional role.

Cereal products as functional foods – Oats, wheat bran, rice bran etc.

UNIT-IV (15 Hrs.)

Functional vegetable products, oil seeds and sea foods.

Coffee, tea and other beverages as functional foods/drinks and their protective effects. Stability of Nutraceutical compounds and estimation of their shelf life.

Recommended Books

1. G. Mazza, 'Functional Foods: Biochemical and Processing Aspects', Techonomic Publication Lancaster, USA.
2. R.S. Kirk and R. Sawyer, 'Pearson's Composition and Analysis of Foods', Wesley Longman Inc. California, USA.
3. R.E.C. Wildman, 'Handbook of Nutraceuticals and Functional Foods', CRC Press, New York, U.S.A.
4. AOAC, 'Official Methods of Analysis', Association of Official Analytical Chemists,USA.

NUTRITION AND HEALTH

Subject Code: MFOT1-157 **L T P C** **4 0 0 4** **Duration: 60Hrs**

Course Objectives:

1. To imparting knowledge about basic terminology of nutrition and different functions of food.
2. To application and role of foods to address various health issues.
3. To creating the awareness regarding social, cultural and physiological aspects of foods.
4. To analyzing the nutritional requirements for different age groups.

Course Outcomes:

1. Imparting knowledge about basic terminology of nutrition and different functions of food.
2. Application and role of foods to address various health issues.
3. Creating the awareness regarding social, cultural and physiological aspects of foods.
4. Analyzing the nutritional requirements for different age groups.

UNIT-I (14 Hrs.)

Foods and Nutrients: Basic definitions, functions of food and nutrients, levels of status, changing concepts of nutrition.
Energy: Energy content of foods, physiological fuel value - review, measurement expenditure. estimating energy requirements of individuals and groups. regulation metabolism, control of food intake and weight.
Energy Balance: Food energy measure, energy control in human metabolism, basal metabolic rate (B.M.R.), factors affecting B.M.R., measuring B.M.R., energy requirements and its estimation.

UNIT-II (16 Hrs.)

Nutrition and Weight Management: Obesity and its causes, body composition, B.M.I., weight for height measures, health implications of obesity, problems of weight management.
Glycaemia Index of Foods: Control its importance.
Recommended dietary allowances (R.D.A.), ICMR standards, food guide, exchange lists, health promotion guidelines
Carbohydrates: Classification, dietary importance, Special functions of carbohydrates in body tissues, Relationship between dietary fiber and various health problems

UNIT-III (16 Hrs.)

Fats: Functions of EFA, role of ω-3, ω -6 fatty acids in health and disease. Trans fatty acids and prostaglandins, essential fatty acids, cholesterol, LDL and HDL and their health importance Proteins: Nature and essentiality of amino acids and proteins, functions of protein, the concept of protein balance, comparative quality of food proteins, biological value, net protein utilization, protein efficiency ratio, therapeutic applications of specific amino acids
Vitamins: Clinical applications, sources, requirements and functions of vitamin A, D, E, K, C and 'B' complex, vitamins toxicity problems.

UNIT-IV (14 Hrs.)

Minerals: Minerals in human health, macro and micro minerals, trace minerals- functions, clinical applications, food sources and requirements
Functional Foods: concept and categories of functional foods and their importance Food security: problem and prospects.

Recommended Books

1. P. Insel, R.E. Turner and D. Ross, 'Discovering Nutrition', ADA, Jones and Bartlett Publishers Inc., USA.
2. S.R. Williams, 'Essentials of Nutrition and Diet Therapy', Mosby Publishing, NewYork, U.S.A.
3. P.V.Hegartyand V. Hegarty, 'Nutrition Food and the Environment', Eagen Press, United States.
4. A.F. Brian and G. Allen, 'Food Science, Nutrition & Health', Edward Arnold, A member of Hodder Headline Group London, Sydney,Auckland.
5. S.R. Mudambi and M.V. Rajagopal, 'Fundamentals of Food & Nutrition'. New Age International (P) Limited, Publishers, New Delhi, India.
6. ICMR, 'Nutrient Requirement & RDA' ICMR, New Delhi.
7. M.J. Gibney, M. Elia, O. Ljungqvist and J. Dowsett, 'Clinical Nutrition', The Nutrition Society Textbook Series, Blackwell Publishing Company.

SEMESTER SECOND

BASIC FOOD ENGINEERING

Subject Code: MFOT1-206 **L T P C** **Duration: 60Hrs.**
4 0 0 4

Course Objectives:
1. To imparting the knowledge about fundamental concepts of food engineering.
2. To understanding the principles of food engineering for efficient utilization of finance and project management in food industry.
3. To analyze different problems related to commercial sterilization of food products.
4. To aware about interpretation of data using psychrometry and synthesis of information for developing appropriate storage and processing conditions.

Course Outcomes:
1. Imparting the knowledge about fundamental concepts of food engineering.
2. Understanding the principles of food engineering for efficient utilization of finance and project management in food industry.
3. Analysis of problems related to commercial sterilization of food products.
4. Interpretation of data using psychrometry and synthesis of information for developing appropriate storage and processing conditions.

UNIT-I (15 Hrs.)

Fundamental Concepts and Definitions: Dimensions and units, thermodynamic systems (closed, open and isolated), intensive and extensive properties, equilibrium state, density, specific volume, specific weight, specific heat, enthalpy, entropy, pressure, temperature scales.
Material Balances: Basic principles, process flow diagrams, total mass balance, component mass balance, material balance problems involved in dilution, concentration and dehydration.

UNIT-II (15 Hrs.)

Energy Balances: Basic principles, energy terms, specific heat of solids and liquids, properties of saturated and superheated steam, heat balances.
Fluid Flow Principles: Fluid statics and dynamics, mass balance and energy balance, Bernoulli's equation, concept of viscosity, Newtonian and non-Newtonian fluids, streamline and turbulent flow, Reynold's number.

UNIT-III (15 Hrs.)

Heat Transfer: Modes of heat transfer, conductive, convective and radiative heat transfer, thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and multilayered systems, estimation of convective heat transfer coefficient, forced convection and free convection, estimation of overall heat transfer coefficient
Heat exchangers: plate, tubular, scraped surface and steam infusion.

UNIT-IV (15 Hrs.)

Thermal Process Calculations: Commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of micro-organisms, lethality function, thermal process calculation for canned foods. Calculation of processing time in continuous flow systems.
Psychrometrics: Properties of dry air: composition of air, specific heat of dry air, enthalpy of dry air and dry bulb temperature.
Properties of Water Vapor: specific volume of water vapor, specific heat of water vapour, Gibbs- Dalton law, Dew point temperature, relative humidity, humidity ratio, wet bulb temperature. Study of Psychrometric chart.

Recommended Books

1. R.P. Singh and D.R. Heldman, 'Introduction to Food Engineering', Academic Press, INC, London.

2. R.L. Earle, 'Unit Operations in Food processing', Pergamon Press Oxford,U.K.
3. R.T. Toledo, 'Fundamentals of Food Process Engineering', CBS Publishers, New Delhi, India.
4. J.C. Batty and S.L. Folkman, 'Food Engineering Fundamentals', John Wiley and Sons, New York,U.S.A.

TECHNOLOGY OF CEREALS & MILLETS

Subject Code: MFOT1-207 **L T P C** **Duration: 60 Hrs**
4 0 0 4

Course Objectives:

1. To imparting the knowledge of structure and chemical composition of different cereal grains.
2. To application of techniques and machineries for the quality assessment of cereal grains and their products.
3. To analyzing the role of ingredients in development of food products from different cereal grains.
4. To understanding the utilization of by-products of milling and formulation of convenience foods for sustainable development.

Course Outcomes:

1. Imparting the knowledge of structure and chemical composition of different cereal grains.
2. Application of techniques and machineries for the quality assessment of cereal grains and their products.
3. Analyzing the role of ingredients in development of food products from different cereal grains.
4. Understanding the utilization of by-products of milling and formulation of convenience foods for sustainable development.

UNIT-I (15 Hrs.)

Wheat Chemistry and Technology: Structure and chemical composition of wheat grain. Criteria of wheat quality – physical and chemical factors. Wheat milling – general principles and operation; cleaning, conditioning and roller milling systems. Flour extraction rates and various flour grades. Criteria of flour quality. Enzymes of wheat and their technological significance.

Dough rheology and its measurement. Functionality of wheat proteins, carbohydrates, lipids and enzymes in bread making. Durum wheat- chemistry, quality and technology of pasta products.

UNIT-II (15 Hrs.)

Bread making processes, importance of critical unit operations, functions of ingredients/additives such as fat, emulsifiers, oxidants, reducing agents and conditioners. Bread faults and remedies.

Technology of biscuit, cake, cookie and cracker manufacturing. Baking powders as leavening agents in bakery industry.

UNIT-III (16 Hrs.)

Rice Chemistry and Technology: Structure and chemical composition of rice grain, milling of rice–types of rice mill; huller mill, Sheller-cum-cone polisher mill. Modern rice milling unit operation-dehusking, paddy separation, polishing and grading. Factors affecting rice yield during milling. By-products of rice milling. Rice parboiling technology. CFTRI process of parboiling.

Properties of parboiled rice, changes during parboiling. Advantages and disadvantages of parboiling. Cooking characteristics of rice. Rice convenience foods: precooked rice, canned rice, expanded rice, rice-based infant food formulae, rice cakes, rice noodles.

UNIT-IV (14 Hrs.)

Corn Technology: Wet and dry milling of corn, products of wet and dry milling of corn, corn sweeteners and their uses.

Malt Technology: Malting of barley: steeping, germination and drying. Different types of malts and their food applications.

Technology of Coarse Cereal Grains: chemical, technological and milling aspects of sorghum, oats and millets.

Recommended Books

1. A.M. Samuel, ‘The Chemistry and Technology of Cereals as Food and Feed’, CBS Publisher &

Distribution, New Delhi, India.
2. Y. Pomeranz, 'Wheat: Chemistry and Technology', American Association of Cereal Chemists, St. Paul, M N,U.S.A.
3. A.C. Eliasson and K. Larsson, 'Cereals in Bread Making', Marcel Dekker. Inc. New York, U.S.A.
4. R.C. Honeney, 'Principles of Cereal Science and Technology', American Association of Cereal Chemists, St. Paul, U.S.A.
5. Y. Pomeranz, 'Advances in Cereal Science and Technology', American Association of Cereal Chemists, St. Paul, U.S.A.
6. B.O. Juliano, 'Rice Chemistry and Technology', American Association of Cereal Chemists, St. Paul, U.S.A.
7. J.M.V. Blanshard, P.J. Frazier and T. Galliard, 'Chemistry and Physics of Baking', Royal Society of Chemistry, London.
8. A.Chakraverty, 'Postharvest Technology of Cereals, Pulses and Oilseeds', Oxford and IBH, New Delhi, India.
9. S.C. Durbey, 'Basic Baking: Science and Craft', Gujarat Agricultural University, Anand (Gujrat).
10. N.L. Kent, 'Technology of Cereals', Pergamon Press, Oxford, UK.
11. R. H. Matthews, 'Legumes: Chemistry, Technology and Human Nutrition, CRC Press York, U.S.A
12. D.K. Salunkhe, S.S. Kadam, 'Handbook of World Food Legumes: Chemistry, processing and Utilization', CRC Press, Florida, U.S.A.

COMPUTER FUNDAMENTALS AND STATISTICS

Subject Code: MFOT1-208 | **L T P C 4 0 0 4** | **Duration: 60Hrs.**

Course Objectives:

1. To imparting the basic knowledge of computer, number system and computer networks.
2. To create the awareness about application of software packages for making reports, documents and effective presentations.
3. To analysis and interpretation of data using statistical techniques.
4. To understanding the types and functions of different hardware and software devices for better project management.

Course Outcomes:

1. Imparting the basic knowledge of computer, number system and computer networks.
2. Application of software packages for making reports, documents and effective presentations.
3. Analysis and interpretation of data using statistical techniques.
4. Understanding the types and functions of different hardware and software devices for better project management.

UNIT-I (15 Hrs.)

Introduction of Computer: Characteristics, classification of computer; block diagram of computer and overview of working.

Number System: Non-positional vs. positional number, binary, octal, decimal, hexa-decimal conversion of number system.

UNIT-II (13 Hrs.)

Hardware: Input, output, and secondary storage devices, central processing unit.

Software: Types of software; meaning, functions and types of operating system.

UNIT-III (17 Hrs.)

Understanding Computer Networks: Types; topologies for LANS, transmission media; analog and digital signals; network security.

Working with Software Packages: An introduction to PC-software packages; word processor- working with text, tables, checking spelling and grammar, printing a document; spreadsheet software-working with worksheet, formulas and functions, inserting charts; PowerPoint presentation-working with different views and designing presentation; window XP-working with files and folders, windows explorer.

Lab.: Windows explorer, MS-Word, MS-Excel, MS-PowerPoint and Internet Surfing.

UNIT-IV (15 Hrs.)

Methods of data collection, sampling and sampling methods, measurement of central tendency, mean, median, mode, standard deviation, standard error, variance. Correlation & regression analysis, analysis of variance (ANOVA), tests of significance, t-test, z- test and f- test.

Recommended Books

1. ‘Introduction to Information Technology’, Pearson Education, New Delhi, India.
2. P.Norton, ‘Introduction to Computers’, TataMcGraw Hill Education Pvt. Ltd., New Delhi, India.
3. D.E. Comer, ‘Computer Networks and Internet’, Pearson Education, New Delhi. India.
4. V. Rajaraman, Fundamentals of Computers, Prentice Hall of India, New Delhi, India.
5. ‘Office 2000: No Experience Required’, BPB Publications, New Delhi, India.
6. A.K. Ray and T. Acharya, Information Technology: Principles and Applications’, Prentice Hall of India, New Delhi, India.
7. A.S. Tanenbaum, ‘Computer Networks’, Eastern Economy Edn., PHI, New Delhi, India.

TECHNOLOGY OF CEREALS LAB - III

Subject Code: MFOT1-209 **L T P C** **Duration: 60Hrs.**
0 0 4 2

Course Objectives:

1. To imparting knowledge of proximate composition of flours from different cereal grains.
2. To understanding the mode of working in industrial setup as an individual and as a team.
3. To evaluation of different properties of cereal starches using modern techniques.
4. To analysis of quality attributes of cereal grains so as to meet legal specifications.

Course Outcomes:

1. Imparting knowledge of proximate composition of flours from different cereal grains.
2. Understanding the mode of working in industrial setup as an individual and as a team.
3. Evaluation of different properties of cereal starches using modern techniques.
4. Analysis of quality attributes of cereal grains so as to meet legal specifications.

PRACTICAL

1. Experimental milling of rice and assessment of presence of head rice yield, broken, immature kernels and degree of polishing.
2. Experimental parboiling of rice by different methods and evaluation of parboiled rice.
3. Determination of proximate analysis of wheat flour for moisture, ash, protein and fat contents.
4. Determination of wet gluten and dry gluten content of given sample of wheat Flour.
5. Determination of alpha-amylase activity in wheat flour by falling number apparatus.
6. Determination of amylose content of cereal and legume starches by iodine binding method.
7. Isolation of rice starch and its quantification.
8. Determination of different cooking parameters of various rice cultivars.
9. Determination of the alcoholic acidity of a given sample of wheat flour.
10. Study of pasting properties of corn starch by Rapid Visco Analyzer.
11. Study of thermal properties of different Cereal starches by Differential Scanning Calorimeter.
12. To compare different types of wheat flours by Polenshke test.
13. Determination of turbidity and percentage light transmittance of cereal starches
14. Determination of textural properties of cooked rice using Texture Analyzer.
15. Experimental baking of different baked products like biscuits, breads and cakes and their evaluation for different parameters.
16. Visit to milling and bakery industry.

TECHNOLOGY OF BEVERAGES

Subject Code: MFOT1-258 **L T PC 4 0 0 4** **Duration: 60Hrs**

Course Objectives:

1. To imparting the knowledge of types and importance of beverages.
2. To understanding the technology behind processing of different beverages to meet the legal specifications.
3. To application of low calorie sweeteners for preparation of beverages to address the specified needs of consumers.
4. To creating awareness to communicate regarding safety levels of additives used in beverage preparation along with quality standards of bottled water.

Objective Outcomes:

1. Imparting the knowledge of types and importance of beverages.
2. Understanding the technology behind processing of different beverages to meet the legal specifications.
3. Application of low calorie sweeteners for preparation of beverages to address the specified needs of consumers.
4. Creating awareness to communicate regarding safety levels of additives used in beverage preparation along with quality standards of bottled water.

UNIT-I (15 Hrs.)

Beverages: Definition, types, importance of beverages in our diets. Treatment of water for food industry. Technology of Alcoholic Beverages: Wine, cider, brandy, perry, toddy, bear and whisky.

UNIT-II (16 Hrs.)

Manufacturing of carbonated beverages and technology of carbonation.
Technology of soft drinks : ingredients and additives used in production of soft drinks.
Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low calorie sweeteners in beverages.

UNIT-III (14 Hrs.)

Production, processing and chemistry of tea manufacturing and types of tea.
Production, processing, roasting and brewing of coffee, soluble coffee, decaffeinated coffee, monsoon coffee, coffee brew concentrate and chicory.

UNIT-IV (15 Hrs.)

Cocoa processing, cocoa beverages and chocolate.
Packaged drinking water- manufacturing processes, quality evaluation of raw and processed water, methods of water treatment, BIS quality standards of bottled water.

Recommended Books

1. D.K. Tressler and M.A. Joslyn, 'Fruit and Vegetable Juice Processing Technology', The AVI Publication Com., Inc.U.S.A.
2. N. Manay Shakuntala and M. Shadaksharaswamy, 'Foods: Facts and Principles', New Age Inter. Publishers, New Delhi,India.
3. N.F. Haard and D.K. Salunkhe, 'Postharvest Biology and Handling of Fruits and Vegetables', AVI Publishing Co. Westport, U.S.A
4. A.A. Kader, 'Postharvest Technology of Horticultural Crops', University of California Division of Agriculture and National Resources, California, U.S.A

TECHNOLOGY OF MALTING AND BREWING

Subject Code: MFOT1-259 **L T PC 4 0 0 4** **Duration: 60 Hrs.**

Course Objectives:

1. To imparting the basic knowledge of production, trade, structure and composition of barley.
2. To application of malt for development of different food products.
3. To quality evaluation of ingredients involved in production of beer.
4. To understanding the techniques involved in processing and quality assessment of beer.

Course Outcomes:

1. Imparting the basic knowledge of production, trade, structure and composition of barley.
2. Application of malt for development of different food products.
3. Quality evaluation of ingredients involved in production of beer.
4. Understanding the techniques involved in processing and quality assessment of beer.

UNIT-I (15 Hrs.)

Barley: Production and trade, composition and structure of barley. preparation and storage of barley for malting, suitability of different cereals for malting, characteristics of barley for malting and brewing, problem of dormancy and water sensibility. Steeping techniques, germination of barley, morphological, enzymatic and chemical changes during malting, role of gibberellic acid in malting, techniques of malting composition of malt, malting of wheat and other cereals. Kilning, changes during kilning, Kilning techniques.

UNIT-II (16 Hrs.)

Quality evaluation of malt, special malts, milling techniques. Significance of water quality in brewing process. Mashing: Changes during mashing, methods of mashing, treatment of cereals used as adjucts, properties and complications of using adjuncts of different sources. Filtration of wort and sparging. Spent grain: Composition and uses.

UNIT-III (15 Hrs.)

Techniques of wort boiling, changes during boiling, hops, selection of hops, acidification of mash, wort cooling, methods of fermentation, management of primary fermentation.

Lagering: objectives and techniques. Beer: Composition, filtration, racking, pasteurization and defects.

UNIT-IV (14 Hrs.)

Application of Malt in Food: baking, infant food etc. Quality control–malt specifications and test procedures. Brewing operations, constituents of hops. brewing adjuncts

Beer Quality–flavor, taste, alcohol content, chemical constituent etc. Head retention–factors affecting head retention. Haze formation.

Recommended Books

1. M.J. Lewis and T.W. Young 'Malting and Brewing Science Vol. I', Springer Science & Business Media,Germany.
2. M.J. Lewis and T.W. Young 'Malting and Brewing Science Vol. II', Springer Science & Business Media, Germany.

FOOD BIOTECHNOLOGY

Subject Code: MFOT1-260 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives:

1. To imparting the knowledge of basic principles of genetic engineering with respect to food.
2. To understanding the applications of bacteriocins in food systems along with their safety levels.
3. To creating awareness of bioethics in food biotechnology.
4. To application of novel processes and techniques for improvement in various foods.

Course Outcomes:

1. Imparting the knowledge of basic principles of genetic engineering with respect to food.
2. Understanding the applications of bacteriocins in food systems along with their safety levels.
3. Creating awareness of bioethics in food biotechnology.
4. Application of novel processes and techniques for improvement in various foods.

UNIT-I (15 Hrs.)

Introduction to Food Biotechnology: basic principles of genetic engineering, improvement of the processing of various crops by genetic engineering, food safety.

UNIT-II (15 Hrs.)

Natural Antimicrobials for Food Preservation: Phytoalexins, essential oils and their components, bacteriocins of Lactic acid bacteria, nisin, pedioc insetc, applications of bacetriocins in food systems. Aflatoxins - production, control and reduction using molecular strategy.

UNIT-III (15 Hrs.)

Protein Engineering in Food Technology: Methods, applications of protein engineering (e.g. glucose isomerase, Lactobacillus beta-galactosidase and peptide antibiotic nisin).

Biotechnology and Food ingredients: biogums, fat substitutes, biocolors, organic acids and sweeteners.

UNIT-IV (15 Hrs.)

Food Biotechnology and Intellectual property rights (IPR), benefits of securing IPRs; bioethics in food biotechnology.

Transgenic Plants and Animals: Their contribution to food production enhancement.

Recommended Books

1. B.H. Lee, ‘Fundamentals of Food Biotechnology’, VCH Publishers, New York, U.S.A.
2. M.P. Tombs, ‘Biotechnology in Food Industry’, Wiley-Blackwell, U.K.
3. D. Knorr, ‘Food Biotechnology’, Marcel Dekker, INC, New York, U.S.A.
4. A. Schwartzberg and A Rao ‘Biotechnology & Food Process Engineering’ Marcel Dekker, INC, New York.
5. I. Goldberg and R. Williams, ‘Biotechnology and Food Ingredients’, Springer Science &Business Media, Germany.
6. R.D. King and P.S.J. Cheetham, ‘Food Biotechnology’, Elsevier Applied Science, London.

FOOD ADDITIVES

Subject Code: MFOT1-261 | **L T P C 4 0 0 4** | **Duration: 60Hrs.**

Course Objectives:

1. To imparting knowledge of types and functions of different food additives.
2. To understanding the limitations of application of food additives in food products.
3. To creating awareness regarding use of food additives and their permissible limits.
4. To applications of recent advances in additives in context to different food attributes.

Course Outcomes:

1. Imparting knowledge of types and functions of different food additives.
2. Understanding the limitations of application of food additives in food products.
3. Creating awareness regarding use of food additives and their permissible limits.
4. Applications of recent advances in additives in context to different food attributes.

UNIT-I (14 Hrs.)

Introduction to Food Additives: General classification, types, uses, functions, legal aspects, risks and benefits.

Preservatives: Antimicrobial agents (types, mode of action and their application), antioxidants (types and mechanism of oxidation inhibition), anti-browning agents (types, functions and modeofaction).

Chelating Agents and Sequestrants: Types, uses and mode of action.

UNIT-II (15 Hrs.)

Acidulants and pH Control Agents: Types, uses and mode of action.

Coloring Agents: Synthetic food colorants, color chemistry, applications and levels of use, natural colorants, sources of natural color (plant, microbial, animal and insects), misbranded colors, color extraction techniques, color stabilization

Flavoring Agents: Flavors (natural and synthetic flavors), off flavor in foods, flavor enhancers, flavor stabilization, flavoren capsulation.

UNIT-III (16 Hrs.)

Sweeteners: Natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products

Emulsifiers: Types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

Stabilizers: Types, uses and functions.

UNIT-IV (15 Hrs.)

Food Spices and Condiments: Types and uses spices and condiments, composition extraction, general processing, uses and special attributes of important Indian spices like pepper, cinnamon, clove, ginger, turmeric, cardamom, fenugreek and fennel etc., seasonings and condiments blends Advances in Food Additives: Classification, functions, safety aspects, recent advances with relevance to color, flavor enhancement, sweeteners and preservatives.

Recommended Books

1. A.L. Branen, 'Food Additives', Marcel Dekker Inc., New York, U.S.A.
2. J.W. Purseglove 'Spices' Longman Publishers, London, England.
3. D.R. Tainter and A.T. Grenis, 'Spices and Seasonings- A Food Technology Handbook', VCH Publishers, Inc., Hoboken,U.S.A.
4. J. Merory, 'Food Flavorings, Composition, Manufacture and Use', AVI Publishing Inc., Westport, U.S.A.
5. K.T. Farrell 'Spices, Condiments and Seasonings', Springer,U.S.A.

SEMESTER THIRD

TECHNOLOGY OF FRUITS AND VEGETABLES

Subject Code: MFOT1-315 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives:

1. To imparting knowledge about classification and nutritional value of fruits and vegetable.
2. To application of appropriate techniques and modern machineries for the production of quality products from fruits and vegetable.
3. To creating awareness about spoilage in fruits and vegetables to avoid the occurrence of food borne illnesses.
4. To development and utilization of by products from fruits and vegetables waste to address the environmental concerns.

Course Outcomes:

1. Imparting knowledge about classification and nutritional value of fruits and vegetable.
2. Application of appropriate techniques and modern machineries for the production of quality products from fruits and vegetable.
3. Creating awareness about spoilage in fruits and vegetables to avoid the occurrence of food borne illnesses.
4. Development and utilization of by products from fruits and vegetables waste to address the environmental concerns.

UNIT-I (15 Hrs.)

Classification and nutritional value of fruits and vegetables. Pre-harvest factors influencing post- harvest physiology, post-harvest handling, physical and chemical techniques to increase the post- harvest life of fresh fruits and vegetables.

Physical and chemical indices of fruit maturity, ripening, bio-chemical changes during ripening, processing and storage.

UNIT-II (15 Hrs.)

Different storage methods for fruits and vegetables like modified atmospheric storage, cold storage, controlled atmospheric storage etc., Pre-processing operations; Washing, blanching, peeling, sorting/grading, peeling, blanching, coring, destoning. Minimal processing of fruits and vegetables, quality factors for processing, fruit product order (FPO).

UNIT-III (15 Hrs.)

Technology of jam, jellies, marmalades, specifications, role of pectin and theories of gel formation.

Technology for juice pressing, juice extraction and clarification, methods of bottling, enzymatic clarification and debittering of juices, fruit juice powders- preparation and packaging.

Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.

Technology of tomato products: Sauce, puree, ketchup and tomato paste

Fruit preserves, candied fruits, dehydrated fruits & vegetables and fruit leather

UNIT-IV (15 Hrs.)

Canning of fruits and vegetables, preparation of syrups and brines, spoilage of canned fruits and vegetables. Fermented vegetable products, By products from fruit and vegetable wastes.

Mushroom Technology: Types of edible mushrooms, processing of mushrooms.

Recommended books:

1. R.P. Srivastava and S. Kumar, ‘Fruit and Vegetable Preservation and Practice’, Bio-Green Books, New Delhi, India.
2. A.K.Thompson,‘FruitandVegetables–Harvesting,HandlingandStorage’,Blackwell

3. Publishing, UK.
4. B. Pantastico, 'Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables', AVI Publishing Company, Inc., Westport, U.S.A.
5. W.V. Cruess, 'Commercial Fruit and Vegetable Products', Allied Scientific Publishers,Bikaner, India.
6. Girdharilal, 'Preservation of Fruits and Vegetables', ICAR, NewDelhi.
7. M.E. Dauthy, 'Fruit and Vegetable Processing', International Book Distributing Co. Lucknow,India.
8. L.P. Hamson, 'Commercial Processing of Vegetables', Noyes Data Corporation, New Jersey.

UNIT OPERATIONS IN FOOD ENGINEERING

Subject Code: MFOT1-311 | **L T PC 4 0 0 4** | **Duration: 60 Hrs.**

Course Objectives:

1. To imparting knowledge of preliminary unit operations.
2. To understanding the principles of food engineering and apply these to manage the projects in industrial set ups.
3. To creating awareness regarding selection and application of tools and techniques used for the production and storage of foods.
4. To formulate and analyze the complex problems of unit operations used in food engineering.

Course Outcomes:

1. Imparting knowledge of preliminary unit operations.
2. Understanding the principles of food engineering and apply these to manage the projects in industrial set ups.
3. Creating awareness regarding selection and application of tools and techniques used for the production and storage of foods.
4. Formulate and analyze the complex problems of unit operations used in food engineering.

UNIT-I (15 Hrs.)

Preliminary Unit Operations: Material handling: Conveyors and elevators, types of conveyors and elevators.

Cleaning: Dry-cleaning; screening, aspiration and magnetic cleaning, wet cleaning; soaking, spray washing, ultrasonic washing, sorting and grading: methods, advantages of sorting and grading.

UNIT-II (15 Hrs.)

Conversion Unit Operations: Size reduction: Benefits, criteria for size reduction, size reduction of solid, fibrous and liquid foods.

Mixing: Mixing terminology, mixers for dry solids (tumbler and vertical screw mixers). mixers for high viscosity pastes (dough mixer), mixers for low viscosity pastes, effect of mixing on foods.

Filtration: Filtration terminology (feed slurry, filtrate, filter medium, filter cake), filtration equipments.

UNIT-III (15 Hrs.)

Processing/Preservation Unit Operations: High temperature operations: Pasteurization, pasteurizer and its functioning.

Evaporation: Single effect evaporator, multiple effect evaporators and plate evaporators, batch type pan evaporators, natural circulation, forced circulation, rising film, falling film and agitated thin film evaporators.

Dehydration: Terminology, dehydration systems; tray drier, tunnel drier, spray drier, fluidized bed drying, vacuum drying and drum driers.

UNIT-IV (15 Hrs.)

Low Temperature Operations: Refrigeration, components of refrigeration system, compressors, condensers and expansion valve, selection of refrigerant, cooling load, coefficient of performance, refrigerant flow rate.

Freezing Systems: Direct contact and indirect systems, freezing load calculations.

Freeze Drying: Conventional drying versus freeze drying, Basic principle, freeze dryer and its components

Recommended Books

1. R.P. Singh and D.R. Heldman, 'Introduction to Food Engineering', Academic Press, INC, London.
2. R.L. Earle, 'Unit Operations in Food processing', Pergamon Press, Oxford,U.K.

3. J.G. Brennan, J. R. Butters, N. D. Cowell and A. E. V. Lilley, 'Food Engineering Operations', Elsevier, New York, U. S.A.
4. J.C. Harper, 'Elements of Food Engineering', AVI, Westport, U.S.A.

FOOD PACKAGING

Subject Code: MFOT1-312	L T P C 3 0 0 3	Duration: 45Hrs.

Course Objective:

1. To imparting knowledge regarding packaging and its functions.
2. To understanding of safety considerations in food packaging.
3. To creating awareness regarding novel methods of food packaging.
4. To selection and application of appropriate packaging materials and techniques depending on the requirements of food products.

Course Outcomes:

1. Imparting knowledge regarding packaging and its functions.
2. Understanding of safety considerations in food packaging.
3. Creating awareness regarding novel methods of food packaging.
4. Selection and application of appropriate packaging materials and techniques depending on the requirements of food products.

UNIT-I (10 Hrs.)

Introduction to food packaging, primary food packaging and secondary packaging, factors involved in the evolution and selection of a food package, functions of food packaging. Packaging requirements of selected foods-cereals and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen food, horticultural products.

Safety Considerations in Food Packaging: Food safety problems associated with package, package labeling and food safety, recycling of packaging materials.

UNIT-II (12 Hrs.)

Paper and Paper Based Packaging Materials: Types of paper (Kraft, bleached, greaseproof) paper products (paper bags, cartoons, drums and molded paper containers), functional properties of paper, testing of paper packaging materials.

Plastic Packaging Materials: Classification of polymers, functional and mechanical.

Properties of thermoplastic polymers, processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing).

UNIT-III (12 Hrs.)

Metal Packaging Materials: Functional properties of metal containers, tin plate containers - quality control tests, can manufacturing and protective coatings.

Glass packaging materials: Composition and manufacturing of glass containers, glass container nomenclature, mechanical and optical properties of glass containers, testing of glass container

Aseptic Packaging of Foods: Sterilization of packaging material, food contact surfaces & aseptic packaging systems, retort pouches.

UNIT-IV (11 Hrs.)

Active Food Packaging: Definition, physical and chemical principles involved.

Edible Films and Coatings as Active Layer: Concept, different edible films used, use of edible active layers to control water vapor transfer and gas exchange

Oxygen Absorbents: Classification and main type of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf -life extension of foods, disadvantages of oxygen absorbents.

Ethanol Vapor: Ethanol vapor generator, uses of ethanol for shelf - life extension of foods, disadvantages of ethanol/vapor generators.

Recommended Books

1. G.L. Robertson, 'Food Packaging: Principles and Practice', Taylor &Francis.
2. S. Sacharow and R.C. Griffin, 'Principles of Foods Packaging', Avi Publication Co. Westport, U.S.A.
3. A.S. Athalye, 'Plastics in Packaging', Tata McGraw Hill Publishing Co., New Delhi, India.
4. M.L. Rooney, 'Active Food Packaging', Blackie Academic & Professional, Glasgow,UK.
5. M. Bakker, 'The Wiley Encyclopedia of Packaging Technology', John Willey & Sons. Inc;_New York, U.S.A.
6. 'Food Packaging Technology Handbook', NIIR Board, National Institute of Industrial Research, New Delhi, India.
7. R. Ahvenainen, 'Novel Food Packaging Techniques', CRC Press, U.S.A.
8. J. Han and J. Han, 'Innovations in Food Packaging', Elsevier Academic Press, U.S.A.
9. R. Coles, D. McDowell and M.J. Kirwan, 'Food Packaging Technology', CRC Press, U.S.A.

TECHNOLOGY OF FRUITS AND VEGETABLES LAB - IV

Subject Code: MFOT1-313 **L T P C** **0 0 4 2** **Duration: 60Hrs.**

Course Objectives:

1. To imparting knowledge regarding extraction of juices and preparation of products from fruits and vegetables.
2. To creating awareness about quality assessment of products for production of quality food.
3. To analyzing the microbiological parameters of the products to meet the safety standards.
4. To evaluating the cost of food products for better management of finance in one's own work and industrial set ups.

Course Outcomes:

1. Imparting knowledge regarding extraction of juices and preparation of products from fruits and vegetables.
2. Creating awareness about quality assessment of products for production of quality food.
3. Analyzing the microbiological parameters of the products to meet the safety standards.
4. Evaluating the cost of food products for better management of finance in one's own work and industrial set ups.

PRACTICALS

1. Extraction of Juices of different fruit (citrus, pomegranate, apple)
2. Evaluation of vitamin C content and
3. Determination of pH
4. Evaluation of browning time
5. Determination of Acidity
6. Cost evaluation of Juice
7. Sensory evaluation of the products
8. Shelf –life study
9. Preparation of jams (using different fruits)and
10. Determination of pectin content
11. Evaluation of Total Soluble Solids(TSS)
12. Evaluation of sugars using lane eynon method
13. Determination of pH
14. Evaluation of acidity
15. Sensory evaluation of the products
16. Cost evaluation product prepared sensory evaluation & organoleptic test
17. Preparation of jelly and
18. Estimation of Pectin content
19. Determination of total soluble solids(TSS)
20. Jelmeter test
21. Checking for pH
22. Checking of acidity
23. Cost evaluation of product
24. Microbiological analysis
25. Sensory evaluation of the products
26. Preparation of marmalade (using different fruits)
27. Jam Marmalade
28. Jelly Marmalade

29. Preparation of preserves and candies
30. Evaluation of TSS
31. Determination of Endpoint
32. Microbiological Analysis
33. Evaluation of product cost
34. Sensory evaluation of the products
35. Preparation of potato chips and
36. Calculation of product dimension
37. Determination of time-temp combination for product
38. Study of the effect of anti-browning agents
39. Preparation of tomato products (Sauce, Ketchup, Soup, puree)for
40. Evaluation of TSS
41. Evaluation of pH
42. Evaluation of acidity
43. Cost evaluation
44. Microbiological analysis
45. Pickling & fermented products
46. Preparation and shelf-life study of ready-to-serve beverages
47. Experimental studies on drying and dehydration of fruits and vegetables.

FOOD PACKAGING LAB - V

Subject Code: MFOT1-314 **L T P C** **Duration: 60Hrs.**
0 0 4 2

Course Objectives:

1. To identification of different packaging materials as per the requirements of food products using principles of food packaging.
2. To understanding the application of novel food packaging techniques.
3. To evaluating the quality of packaged food products so as to provide safe food for consumption.
4. To analyzing the physical parameters of packaging materials to meet the legal specifications.

Course Outcomes:

1. Identification of different packaging materials as per the requirements of food products using principles of food packaging.
2. Understanding the application of novel food packaging techniques.
3. Evaluating the quality of packaged food products so as to provide safe food for consumption.
4. Analyzing the physical parameters of packaging materials to meet the legal specifications.

PRACTICAL

1. Designing of an ideal packaging material for different type of food products.
2. Identification of different packaging materials.
3. Testing of paper based packaging materials.
4. Equilibrium Relative Humidity (ERH) study of foods.
5. To study uniformity and amount of wax in wax paper for packaging of hygroscopic foods.
6. To study chemical resistance of plastic and paper packaging materials.
7. To study Water Vapor Transmission Rates (WVTR) of paper and plastic polymers.
8. Shelf life studies of packaged foods.
9. Study of grease resistance of paper, plastic laminates and aluminum foil for the packaging of fatty foods.
10. To perform various functional tests on corrugated fiberboard boxes.
11. Determination of Cobb value of different types of paperboard.
12. Shrink packaging of poultry products.
13. Aseptic packaging of different food products.
14. Vacuum packaging of dry powders.
15. Testing of glass containers for thermal shock resistance.
16. Determination of tensile strength and heat seal strength of different plastics.
17. To conduct drop and vibration tests on different types of corrugated fiberboard boxes.
18. Determination of tin coating weight and porosity of tin plate container.
19. Determination of lacquer coating in tin containers.
20. Study of manufacture of 2-piece and 3-piece metal cans.
21. Visit to paper manufacturing industry.

FOOD STANDARDS AND QUALITY ASSURANCE

Subject Code: MFOT1-364 **L T PC** **Duration: 60Hrs.**
3 0 0 3

Course Objectives:

1. To imparting knowledge of concepts of food quality and assurance.
2. To understanding the laws and regulation in relations to food quality and safety.
3. To applications of good hygiene and good laboratory practices with respect to environmental considerations.
4. To creating awareness about various sampling techniques and analysis of data using statistical quality control.

Course Outcomes:

1. Imparting knowledge of concepts of food quality and assurance.
2. Understanding the laws and regulation in relations to food quality and safety.
3. Applications of good hygiene and good laboratory practices with respect to environmental considerations.
4. Creating awareness about various sampling techniques and analysis of data using statistical quality control.

UNIT-I (15 Hrs.)

Introduction to concepts of food quality, quality control, quality control cycle, responsibilities of quality control department, food safety, Current challenges to food safety
Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

UNIT-II (15 Hrs.)

Principles of food quality assurance, total quality management (TQM), good manufacturing /management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control, food safety management, applications of HACCP in food safety, concept of food traceability for food safety

UNIT-III (15 Hrs.)

Microbial Quality Control: Determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry, Sampling techniques

UNIT-IV (15 Hrs.)

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Codex alimentarious commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 1400

Recommended Books

1. R. Early, ‘Guide to Quality Management Systems for the Food Industry’, Blackie, Academic and Professional, London.
2. W.A. Gould and R.W. Gould, ‘Total Quality Assurance for the Food Industries’, CTI Publications Inc. Baltimore.
3. Y. Pomeraz and C.E. MeLoari, ‘Food Analysis: Theory and Practice’, CBS Publishers and Distributor, New Delhi, India.
4. F.L. Bryan, ‘Hazard Analysis Critical Control Point Evaluations- A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage’, World Health Organization,

Geneva.
5. R. Kirk and R. Sawyer, ‘Pearson’s Composition and Analysis of Food’, Longman Scientific and Technical, England.
6. ‘Manuals of Food Quality Control, Additives Contaminants Techniques’, Food and Agricultural Organization, Rome.
7. T.E. Furia, ‘Regulatory Status of Direct Food Additives’, CRC Press, Florida, U.S.A.

TECHNOLOGY OF PULSES AND OIL SEEDS

Subject Code: MFOT1-363 **L T P C** **Duration: 60 Hrs.**
3 0 0 3

Course Objective:

1. To imparting knowledge about importance of fats and oils in human nutrition.
2. To understanding the importance of oilseed processing and applying these to one's own work and in industrial setups.
3. To creating awareness about selection and application of techniques and machineries in milling and extraction processes.
4. To demonstrating knowledge about anti-nutritional factors and their modes of elimination so as to ensure public health.

Course outcomes:

1. Imparting knowledge about importance of fats and oils in human nutrition.
2. Understanding the importance of oilseed processing and applying these to one's own work and in industrial setups.
3. Creating awareness about selection and application of techniques and machineries in milling and extraction processes.
4. Demonstrating knowledge about anti-nutritional factors and their modes of elimination so as to ensure public health.

UNIT-I (15 Hrs.)

Importance of fats and oils in human nutrition, Chemical, physical and functional properties of fats and oils.
Importance of oilseeds processing in India.

UNIT-II (15 Hrs.)

Commercial oil resources, basic processing of fats and oils - oil extraction, expeller pressing and solvent extraction, degumming, refining, bleaching, hydrogenation, fractional cystallization, inter-esterification, glycerolizes, molecular distillation, plasticizing and tempering. Preparation of protein concentrates and isolates and their use in high protein foods, fermented and traditional products.

UNIT-III (15 Hrs.)

Fat substitutes and mimetics.
Common pulses produced in the country. Soybean: processing and utilization.
Milling methods for pulses, home scale commercial and recent methods with equipment's.

UNIT-IV (15 Hrs.)

Anti-nutrients in pulses and modes of elimination.
Main processing methods: Cooking, germination, sprouting, fermentation, roasting, puffing, frying and extrusion cooking etc.
Products from legumes and uses: Starch, flour, protein concentrates and isolates.

Recommended Books

1. R.J. Hamilton and A. Bharti, 'Fats and Oils: Chemistry and Technology', Applied Science, London.
2. D.K. Salunkhe, J.K, Chavan, R.N. Adsule and S.S. Kadam, 'World Oilseeds: Chemistry, Technology and Utilization', VNR, New York, U.S.A.
3. I.A. Wolf, 'Handbook of Processing and Utilization in Agriculture', CRC Press, Florida, U.S.A.

SEMESTER FOUR

TECHNOLOGY OF EGG, MEAT, FISH AND POULTRY

Subject Code: MFOT1-415 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives:

1. To imparting knowledge about composition and nutritional value of meat, fish and poultry.
2. To applying ethical principles in various practices involved in slaughtering of animals.
3. To evaluation of internal and external quality parameters of egg to ensure safety for consumption.
4. To creating awareness regarding utilization of by products from meat industry in context to environment.

Course Outcomes:

1. Imparting knowledge about composition and nutritional value of meat, fish and poultry.
2. Applying ethical principles in various practices involved in slaughtering of animals.
3. Evaluation of internal and external quality parameters of egg to ensure safety for consumption.
4. Creating awareness regarding utilization of by products from meat industry in context to environment.

UNIT-I (15 Hrs.)

Status and scope of meat industry in India. Structure and physico-chemical properties of muscle. Meat: Composition and nutritive value, conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, rigor mortis, cold shortening, pre-rigor processing.

UNIT-II (15 Hrs.)

Aging of meat, meat tenderization- natural and artificial methods. Properties of fresh meat-water holding capacity, color, palatability.
Cooking methods for meat.
Storage and preservation of meat: Chilling, freezing, curing, smoking, dehydration, canning. Spoilage of meat.

UNIT-III (15 Hrs.)

Restructured meat products, meat analouges.
Meat industry by products: Importance and applications.
Fish: Factors affecting quality of fresh fish, fish dressing, chilling, freezing, salting and canning of fish.
Manufacturing of fish oil, fish protein concentrate, fish meal. By-products of fish industry, their technology of utilization.

UNIT-IV (15 Hrs.)

Egg: Structure, composition, nutritive and functional properties.
Quality of Egg: Internal quality evaluation, egg candling, egg grading, microbial spoilage of eggs, preservation and storage methods for eggs.
Egg powder.
Packaging and transportation of eggs.
Poultry: Types, chemical and nutritive value of poultry meat, poultry dressing and slaughtering methods, preservation, grading and packaging of poultry meat.

Recommended Books

1. W.J. Stadelman and J. Owen,‘Egg Science & Technology’, AVI Publishing Company, INC. Westport, U.S.A.
2. R.A. Lawrie and D. Ledward, ‘Lawrie’s Meat Science’, Woodhead Publishers,UK.
3. G. Mead, ‘Poultry Meat Processing and Quality’, Woodhead Publishers, UK.
4. P.C. Panda, ‘Text Book on Egg and Poultry Technology’, Vikas Publishers, Chennai, India.

TECHNOLOGY OF MILK AND MILK PRODUCTS

Subject Code: MFOT1-416 **L T P C** **Duration: 60Hrs.**
4 0 0 4

Course Objectives:

1. To imparting knowledge about composition, nutritive value and processing of milk and milk products.
2. To understanding the microbiological quality of fresh milk to ensure its safety for human consumption and processing.
3. To cost effective utilization of by-products of dairy industry to address the environmental concerns.
4. To creating awareness about scope, strengths and opportunities of dairy industry and its implementation to become entrepreneur.

Course Outcomes:

1. Imparting knowledge about composition, nutritive value and processing of milk and milk products.
2. Understanding the microbiological quality of fresh milk to ensure its safety for human consumption and processing.
3. Cost effective utilization of by-products of dairy industry to address the environmental concerns.
4. Creating awareness about scope, strengths and opportunities of dairy industry and its implementation to become entrepreneur.

UNIT-I (15 Hrs.)

Dairy Industry in India: Scope, strengths and opportunities for dairy industry.
Milk: Definition, composition and nutritive value, factors affecting composition of milk. Physicochemical properties and nutritive value of milk.
Liquid Milk Processing: filtration/clarification, standardization, pasteurization (LTLT, HTST, UHT), homogenization.
Microbiology of milk

UNIT-II (15 Hrs.)

Technology of Recombined and Reconstituted Milk: Composition, process of manufacture, defects
Technology of Condensed and Evaporated Milk: process of manufacture, defects (their causes and prevention).
Technology of Milk Powders (WMP, SMP): process of manufacture, defects (their causes and prevention), instantization of milk powder.
Technology of Indigenous Milk Products: Dahi, butter, ghee, channa, paneer etc.

UNIT-III (15 Hrs.)

Technology of Cheese: Classification, composition, nutritive value, process of manufacture of cheddar, mozzarella, cottage and processed cheese, defects (their causes and prevention).
Technology of frozen milk products: process of manufacture, defects (their causes and prevention).

UNIT-IV (15 Hrs.)

Milk and Milk Product Standards and Legislations in India: Grading of milk and criterion of grading, reconstituted milk, synthetic milk.
Membrane Processing of Milk: types of membranes, applications of reverse osmosis, ultra filtration and microfiltration in dairy industry.
Milk adulteration, synthetic milk. By products of dairy industry and their utilization. Imitation dairy products.

Recommended Books:

1. Sukumar, De ‘Outlines of Dairy Technology’, Oxford University Press,UK.
2. G. Smith, ‘Dairy processing improving quality’, Woodhead Publishers, New Delhi,India.

3. A.T. Andrews and J. R. Varley, 'Biochemistry of Milk Products' Woodhead Publishers, New Delhi, India.
4. R. Early, 'Technology of Dairy Products', Springer Science & Business Media, Germany.
5. R.P. Aneja, B.N. Mathur, R.C. Chandan and A.K. Banerjee, 'Technology of Indian Milk Products', Dairy India Publishers, New Delhi, India.

FOOD ANALYSIS AND INSTRUMENTATION

Subject Code: MFOT1-417 **L T PC 3 0 0 3** **Duration: 45Hrs.**

Course Objectives:

1. To imparting knowledge about proximate analysis of food products.
2. To understanding the selection and application of appropriate modern techniques for quality assessment of foods.
3. To creating awareness regarding sampling techniques, statistical analysis and interpretation of data along with expression of results.
4. To application of novel methodologies for microbial load analysis of food to ensure safety for consumption.

Course Outcomes:

1. Imparting knowledge about proximate analysis of food products.
2. Understanding the selection and application of appropriate modern techniques for quality assessment of foods.
3. Creating awareness regarding sampling techniques, statistical analysis and interpretation of data along with expression of results.
4. Application of novel methodologies for microbial load analysis of food to ensure safety for consumption.

UNIT-I (10 Hrs.)

Introduction to food analysis, types of samples and sampling techniques, storage and preservation of samples, expression of results.

Proximate Analysis of Foods: Principles of moisture, fat, protein, carbohydrates, crude fiber and vitamins in foods.

UNIT-II (10 Hrs.)

Sensory Analysis of Foods: Overview of the sensory principles and practices, selection and screening of the sensory panel, types of panel (trained, semi trained), methodology of sensory evaluation: discriminative tests: difference tests, paired comparison, duo trio, triangle; descriptive tests.

UNIT-III (12 Hrs.)

Instrumentation in Food Analysis: Principles, types and applications of spectroscopy, photometry, electrophoresis; chromatography and atomic absorption spectro photometry.

UNIT-IV (13 Hrs.)

Instrumentation in Food Analysis: Color measurement in foods; X-ray analysis of foods and its applications; mass spectroscopy; nuclear magnetic resonance (NMR); differential scanning calorimetry (DSC).

Refractometry and ultrasonic in food analysis; texture analysis in foods, sensory versus instrumental analysis of texture, rapid methods of microbial analysis; immunoassays methods.

Recommended Books

1. R.S. Kirk and R. Sawyer, ‘Pearson’s Composition & Analysis of foods’, Longman Scientific and Technical, UK.
2. G.G. Birk, J.G. Herman and K.J. Parker, ‘Sensory Properties of Foods’, Applied Science, London.

TECHNOLOGY OF ANIMAL PRODUCTS LAB -VI

Subject Code: MFOT1-418 **L TPC 0 0 4 2** **Duration: 60 Hrs.**

Course Objectives:

1. To imparting knowledge development of various processed foods from animal products.
2. To understanding the mode of working in industrial setup as an individual and as a team.
3. To evaluation of microbiological quality of milk and milk products to ensure their safety for consumption.
4. To analysis of quality parameters of animal products so as to meet the legal specifications.

Course Outcomes:

1. Imparting knowledge development of various processed foods from animal products.
2. Understanding the mode of working in industrial setup as an individual and as a team.
3. Evaluation of microbiological quality of milk and milk products to ensure their safety for consumption.
4. Analysis of quality parameters of animal products so as to meet the legal specifications.

PRACTICALS

1. Determination of specific gravity, total solids (T.S) % and SNF (Solid not fat) % in the given milk sample.
2. Determination of percentage fat in the given sample of milk by Gerber centrifuge method.
3. Determination of titrable acidity (T.A.) and pH of milk.
4. Determination of added Urea in the given sample of milk.
5. Determination of added starch in the given sample of milk.
6. To conduct clot on boiling (COB) and Alcohol – Alizarin test for testing milk quality.
7. Determination of added water in a given sample of milk.
8. Preparation qualitative testing of milk products like Chhana, Khoa and Paneer, Icecream.
9. Determination of added preservatives, neutralizers in the given sample of milk.
10. Estimation of bacterial numbers in a given sample of milk by direct microscopic count in a given sample of milk.
11. Determination of microbiological quality of milk of MBR test.
12. To study dismantling, cleaning and assembling of HTST pasteurizer for milk.
13. Separation of cream by cream separator.
14. Visit to a milk collection/chilling and milk processing plant.
15. Determination of external and internal quality of poultry egg.
16. To study the effect of time, temperature on coagulation properties of egg.
17. Determination of time temperature condition on formation of iron sulphide in egg.
18. Preservation and evaluation of different egg products.
19. Preparation and evaluation of different egg products
20. Preparation of different types of meat products using different methods of preservation.
21. Visit to meat, fish and poultry processing industries.
22. Determination of tenderness and water holding capacity of different meat.

Total Credits= 22

Semester VI		Contact Hours			Max Marks		Total Marks	Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.		
BAGRS1-651	Rainfed Agriculture & Watershed Management	1	0	0	40	60	**100**	**1**
BAGRS1-652	Protected Cultivation and Secondary Agriculture	1	0	0	40	60	**100**	**1**
BAGRS1-653	Diseases of Field and Horticultural Crops and their Management-II	2	0	0	40	60	**100**	**2**
BAGRS1-654	Post-harvest Management and Value Addition of Fruits and Vegetables	1	0	0	40	60	**100**	**1**
BAGRS1-655	Management of Beneficial Insects	**1**	**0**	**0**	**40**	**60**	**100**	**1**
BAGRS1-656	Crop Improvement-II *(Rabi crops)*	**1**	**0**	**0**	**40**	**60**	**100**	**1**
BAGRS1-657	Principles of Organic Farming	**1**	**0**	0	**40**	**60**	**100**	**1**
BAGRS1-658	Farm Management, Production & Resource Economics	**1**	**0**	0	**40**	**60**	**100**	**1**
BAGRS1-659	Principles of Food Science and Nutrition	**2**	**0**	0	40	60	**100**	**2**
BAGRS1-660	Rainfed Agriculture & Watershed Management Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-661	Protected Cultivation and Secondary Agriculture Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-662	Diseases of Field and Horticultural Crops and their Management-II Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-663	Post-harvest Management and Value Addition of Fruits and Vegetables Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-664	Management of Beneficial Insects Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-665	Crop Improvement-II *(Rabi crops)* Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-666	Principles of Organic Farming Lab	**0**	**0**	2	20	30	**50**	**1**
BAGRS1-667	Farm Management, Production & Resource Economics Lab	**0**	**0**	2	20	30	**50**	**1**
	ELECTIVE							
XXXXX	Hi-tech. Horticulture/ Agricultural Journalism/ Food Safety and Standards/ Agri-business Management	2	0	0	40	60	100	2
XXXXX	Hi-tech. Horticulture/ Agricultural Journalism/ Food Safety and Standards/ Agri-business Management Lab	0	0	2	20	30	50	1
Total		**13**	**0**	**18**	**580**	**870**	**1450**	**22**

Electives:
1. Hi-tech. Horticulture: **BAGRD1-671**
2. Agricultural Journalism: **BAGRD1-672**
3. Food Safety and Standards: **BAGRD1-673**
4. Agri-business Management: **BAGRD1-674**

Electives Lab:
1. Hi-tech. Horticulture Lab: **BAGRD1-675**
2. Agricultural Journalism Lab: **BAGRD1-676**
3. Food Safety and Standards Lab: **BAGRD1-677**
4. Agri-business Management Lab: **BAGRD1-678**

Overall Marks / Credits

Semester	Marks	Credits
V	1300	22
VI	1450	22
Total	**2750**	**44**

SEMESTER

VI

Rainfed Agriculture & Watershed Management

Subject Code: BAGRS1-651 | **L T P C** 1 0 0 1 | **Duration: 15 (Hrs.)**

L	T	P	C
1	0	0	1

Course Objectives:

The Specific objectives of this course are to make students able to:

1. know about meaning, definition, concept of rainfed agriculture and watershed management in India.
2. understand soil, water and climatic conditions prevalent in rainfed areas.
3. comprehend soil and water conservation techniques, watershed management including contingent crop planning and adaptation irrigation mechanisms to counter droughts.

Course Outcomes: Students will be able to:

CO1. learn farming practices that rely on rainfall for water.
CO2. study comprehensive assessment of water management in agriculture.
CO3 make use of water for a larger area by suitable watershed management techniques.
CO4. conserve the soil by adopting latest soil conservation techniques.
CO5. learn the concept of integrated watershed management (IWM).

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								3				
CO2			2									
CO3					1							
CO4	1											
CO5							1					

UNIT-I (4 Hours)

Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India; Problems and prospects of rain fed agriculture in India.

UNIT-II (4 Hours)

Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio-morphological characteristics of the plants, Crop adaptation and mitigation to drought.

UNIT-III (4 Hours)

Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions.

UNIT-IV (3 Hours)

Concept, objective, principles and components of watershed management, factors affecting watershed management, problems and approach

Recommended Text Books / Reference Books:
1. S.R.Reddy, 1999. Principles of Agronomy. Kalyani Publishers, New Delhi.
2. T.Yellamanda Reddy and G.H.Sankara Reddi, 2010. Principles of Agronomy. Kalyani Publishers, New Delhi.
3. Reddy, S. R. and Prabhakar Reddy, G. 2015. Dryland Agriculture. Kalyani Publishers.
4. Arnon,I. 1972. Crop Production in Dry Regions (Vol.I), Leonard Hill Pub. Co, London.
5. Dhruva Narayana, V.V., Sastry, G.S. and Patnaiak, V.S. 1999. Watershed Management in India. ICAR, New Delhi.
6. Jeevananda Reddy,S.2002. Dryland Agriculture in India: An agro-climatological and agro meteorological perspective. B S publications

Protected Cultivation and Secondary Agriculture

Subject Code: BAGRS1-652 | **L T P C** 1 0 0 1 | **Duration: 15 (Hrs.)**

Course Objectives: **The specific objectives of this course are to:**
1. Familiarize the students with the design of greenhouse, cost estimation and economic analysis.
2. Develop skill to erect protected structure equipped with irrigation, active and passive solar heating systems, drying.
3. Enable the students to know about important engineering properties and their application in post harvest technology equipments design and operation.

Course Outcomes: Students will be able to
CO1. learn about greenhouse technology, types of green houses and construction of green houses.
CO2. gain knowledge of greenhouse equipments, materials of construction for traditional and low cost green houses.
CO3. learn about Irrigation systems used in greenhouses, shade net house in protected cultivation.
CO4. grab the of knowledge of cleaning and grading moisture measurement.
CO5. understand the material handling equipment, principle and working.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									1			
CO2					1							
CO3		2										
CO4											2	
CO5							1					

UNIT-I (3 Hours)

Greenhouse technology: Introduction, Types of Greenhouses; Plant response to Greenhouse environment, Planning and design of greenhouses, Design criteria of green house for cooling and heating purposes.

UNIT-II (4 Hours)

Greenhouse equipment, materials of construction for traditional and low cost greenhouses. Irrigation systems used in greenhouses, typical applications, passive solar greenhouse, hot air greenhouse heating systems, greenhouse drying.

UNIT-III (4 Hours)

Important Engineering properties such as physical, thermal, aero & hydrodynamic properties of cereals, pulses and oilseed, their application in PHT equipment design and operation. Drying and dehydration.

UNIT-IV (4 Hours)

Moisture measurement, EMC, drying theory, various drying methods, commercial grain dryer (deep bed dryer, flat bed dryer, tray dryer, fluidized bed dryer, circulatory dryer and solar dryer), Material handling equipment; conveyer and elevators, their principle, working and selection.

Recommended Text Books / Reference Books:

1. Prasad Kumar. Green House Management for Horticulture Crops
2. Radha Manohar, K and Igathinathane. C. Greenhouse Technology and Management, 2nd Edition, BS Publications.
3. Tiwari, G.N. Greenhouse Technology for Controlled Environment. Narosa Publishing house Pvt.Ltd.
4. Singh Brahma and Balraj Singh., 2014. Advances in Protected Cultivation, New India Publishing Company.
5. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi.
6. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi.
7. Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag, New Delhi.

Diseases of Field and Horticultural Crops and their Management-II

Subject Code: BAGRS1-653 | **L T P C** 2 0 0 2 | **Duration: 30 (Hrs.)**

Course Objectives: The specific objectives of this course are to make the students to:

1. Know the symptoms, etiology, disease cycle and management of various field crops and horticultural crops.
2.Identify, diagnosis and treatment of selected horticulture and field crops.
3. Compare the means of dispersal of these diseases.

Course Outcomes: Students will be able to:

CO1. know the common pathogens of different diseases.
CO2. acquire the knowledge about etiology and symptoms of these diseases which helps in diagnosis of the diseases of field and horticultural crops.
CO3. learn means of dispersal of these diseases suitable management methods can be applied.
CO4. learn eco-friendly and economically suitable management practices may be adopted.
CO5. understand different chemical control methods.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3								
CO2								1				
CO3		2										
CO4												1
CO5							3					

UNIT-I (9 Hours)

Economic importance, symptoms, causal organism, epidemiology, disease cycle and integrated management of diseases of wheat, barley, sugarcane, rapeseed & mustard, sesamum, sunflower, cotton, pulses.

UNIT-II (6 Hours)

Economic importance, symptoms, causal organism, epidemiology, disease cycle and integrated management of mentha, coriander, turmeric and berseem.

UNIT-III (9 Hours)

Economic importance, symptoms, causal organism, epidemiology, disease cycle and integrated management of diseases of citrus, mango, grapevine, sapota, ber, apple, pear, peach, plum, coconut, mulberry, chilli, potato, pea, onion, garlic cucurbits.

UNIT-IV (6 Hours)

Economic importance, symptoms, causal organism, epidemiology, disease cycle and integrated management of diseases of rose, chrysanthemum, gladiolus, marigold and jasmine.

Recommended Text Books / Reference Books:

1. Rangaswami, G & Mahadevan, K.2001. Diseases of crop plants in India, Prentice Hall of India Pvt.Ltd, New Delhi.
2. Singh, R.S.2005. Plant Diseases. Oxford & IBH Publications, New Delhi
3. Pathak, V.N.2001. Diseases of Fruit crops. Oxford & IBH Publications, New Delhi
4. Singh, R.S.1999. Diseases of Vegetable crops. Oxford & IBH Publications, New Delhi
5. Chaube, H.S and V.S. Pundhir, 2012. Crop Diseases & Their Management. PHI Pvt. Ltd, New Delhi

Post-harvest Management and Value Addition of Fruits and Vegetables

Subject Code: BAGRS1-654 | **L T P C** 1 0 0 1 | **Duration: 15 (Hrs.)**

Course Objective: The specific objectives of this course are to:
1. acquaint student the importance of post-harvest management and processing of fruits and vegetables.
2. impart knowledge about pre and postharvest factors affecting quality of horticultural produce
3. provide technical know-how on value addition of fruits/vegetables through different methods and to design storage structures for freshly harvested agricultural products in the field

Course Outcomes: Students will be able to:
CO1. understand the post-harvest technology of horticultural crops.
CO2. recognise the value addition of horticulture crops.
CO3. handle the tool and equipment design for PHT (Post harvest technology) and value addition.
CO4. study the various certification and accreditation i.e. FPO, ISO and other labelling.
CO5. gain knowledge about the tomato processing, caning and drying of fruits and vegetables and various management technologies of food related to conventional and modern packaging methods

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1									

CO2					2							
CO3							2					
CO4					3							
CO5								1				

UNIT-I (4 Hours)

Importance of post-harvest processing of fruits and vegetables, extent and possible causes of post harvest losses; Pre-harvest factors affecting postharvest quality, maturity, ripening and changes occurring during ripening;

UNIT-II (3 Hours)

Respiration and factors affecting respiration rate; Harvesting and field handling; post harvest practices; Storage (ZECC, cold storage, CA, MA, and hypobaric)

UNIT-III (4 Hours)

Value addition concept; Principles and methods of preservation; Intermediate moisture food- Jam, jelly, marmalade, preserve, candy– Concepts and Standards; Fermented and non-fermented beverages.

UNIT-IV (4 Hours)

Tomato products- Concepts and Standards; Drying/ Dehydration of fruits and vegetables– Concept and methods, osmotic drying. Canning– Concepts and Standards, packaging of products.

Recommended Text Books / Reference Books:

1. P.H.Pandey. Principles & Practices of Post Harvest Technology
2. Amar Singh. Fruit Physiology and Production
3. Rathore, N.S., Mathur, G.K., Chasta, S.S. 2012. Post-harvest Management and Processing of Fruits and Vegetables. ICAR, New Delhi.
4. Srivastava, R.P. and Sanjeev Kumar. 2002. Fruit and Vegetable Preservation: Principles and Practices. International Book Distribution Company, Lucknow.
5. Giridharilal, G.S., Siddappa and Tondon, G.L. 2007. Preservation of Fruits and Vegetables. ICAR, New Delhi.
6. Mitra, S.K. 2005. Post Harvest Physiology and Storage of Tropical and Subtropical Fruits. CABI Publishers, Kolkatta.

Management of Beneficial Insects

Subject Code: BAGRS1-655 | **L T P C** 1 0 0 1 | **Duration: 15 (Hrs.)**

Course Objectives: **The specific objectives of this course are to make the students able to:**
1. know about importance of beneficial insects. Understand bee, silk and lac biology, morphology of host plants and their pest and diseases.
2. comprehend methods of rearing and management practices of bee keeping, mulberry and lac cultivation.
3. identify parasitoids and predators used in biological control of pests in bee, silk and lac cultivation and become familiarize with equipment's used in their production.

Course Outcomes: Students will be able to

CO1. practice apiculture, sericulture and lac culture as an entrepreneur according to agro climatic zone.
CO2. understand commercial methods of rearing, equipment, seasonal management, insect pest and disease.
CO3. identify different bio control agents (Predator, Parasite and Parasitoids) and their use for sustainable pest management.
CO4. learn about mass multiplication technique of biological control agents and established a bio control lab in future as an entrepreneur.
CO5. know about important species for commercial use of honey bee, silkworm and lac insect.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2									
CO2					1							
CO3						2						
CO4				3								
CO5									2			

UNIT-I (4 Hours)

Importance of beneficial Insects, Beekeeping and pollinators, bee biology, commercial methods of rearing, equipment used, seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honeybee. Role of pollinators in cross pollinated crops. Toxicity of insecticides

UNIT-II (4 Hours)

Types of silkworm and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Rearing, mounting and harvesting of cocoons. Insect-pests and diseases of silkworm and their management. Rearing appliances of mulberry silkworm and methods of disinfection.

UNIT-III (3 Hours)

Lac insects: Species, morphology, biology, host plants. Lac production – seed lac, button lac, shellac, lac-products. Identification of major parasitoids and predators commonly being used in biological control.

UNIT-IV (4 Hours)

Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance. An introduction to economics and marketing of honey, silk and lac.

Recommended Text Books / Reference Books:

1. Aruga H. 1994. Principles of Sericulture. Oxford & IBH, New Delhi.
2. B.Vasanta Raj. Elements of Economic Entomology
3. Atwal AS. 2006. The World of the Honey Bee. Kalyani Publ., New Delhi.
4. Ganga G. 2003. Comprehensive Sericulture. Vol. II.Silkworm Rearing and Silk Reeling. Oxford & IBH, New Delhi.
5. Partiban S & David BV. 2007. Management of Household Pests and Public Health Pests. Namratha Publ., Chennai.
6. Singh S. 1975. Beekeeping in India. ICAR, New Delhi.

Crop Improvement-II *(Rabi crops)*

Subject Code: BAGRS1-656 | **L T P C** 1 0 0 1 | **Duration: 15 (Hrs.)**

Course Objective: **The specific objectives of this course will be to make the students to:**

1. gain the knowledge on the centre of origin, distribution and wild relatives of various rabi crops
2. understand the genetics of qualitative and quantitative characters and plant genetic resources and their conservation process.
3. understand the major breeding objectives, procedures and innovative approaches for development of hybrids and varieties for different purposes.

Course Outcomes: Students will be able:

CO1. learn importance of wild relative to produce new varieties of Rabi crop.
CO2. learn Gene preservation method for further use to improve Rabi varieties.
CO3. apply breeding methods to improve Rabi crops.
CO4. identify resistance genes related to Rabi crop with high yield potential against Pest and pathogen and utilization genes.
CO5. learn new genetic approaches to achieve a definite ideotype of rabi crop.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3								
CO2								1				
CO3			1									
CO4	2											
CO5										2		

UNIT-I (3 Hours)

Centres of origin, distribution of species, wild relatives in different cereals, pulses, oilseeds, fodder crops and cash crops, Problems and present status of crop improvement in India with emphasis on the work done in Punjab. National and International centres of crop improvement

UNIT-II (3 Hours)

Plant genetic resources, its utilization and conservation; study of genetics of qualitative and quantitative characters. Conventional versus non-conventional methods for crop improvement.

UNIT-III (6 Hours)

Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality (physical, chemical, nutritional).

UNIT-IV (3 Hours)

Hybrid seed production technology of rabi crops. Ideotypes concept and climate resilient crop varieties for future.

Recommended Text Books / Reference Books:
1. Allard, R.W. 1960. Principles of Plant Breeding. John Wiley & Sons, New York.
2. Phundan Singh. 2006. Essential of Plant Breeding. Kalyani Publishers, Ludhiana. 54
3. Poehlman, J.M. and Borthakur, D. 1995. Breeding of Asian Field Crops. Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Sharma, J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
5. Kalloo, G.1994. Vegetable Breeding. Panima Educational Book Agency, New Delhi.
6. Kumar, N. 2006. Breeding of Horticultural Crops - Principles and Practices. New India Publishing Agency, New Delhi.
7. George Acquaah..2012. Principles of Plant Genetics and Breeding. Blackwell Publishing Ltd., USA.

Principles of Organic Farming

Subject Code: BAGRS1-657 | **L T P C** 1 0 0 1 | **Duration: 15 (Hrs.)**

Course Objective: **The specific objectives of this course will be to make the students to:**
1. understand meaning, concepts and principles of organic farming and initiatives taken by government, NGOs and private sector for its promotion.
2. know about Organic ecosystem and Organic nutrient resources and its fortification.
3. comprehend choice of crops and varieties in organic farming and use of organic inputs for management of insect, pest, disease and weed.

Course Outcomes: Students will be able to:
CO1. make proper use of initiatives taken by Government for organic produce.
CO2. evaluate the role of NGOs in producing organic products.
CO3. select the crops and varieties for organic produce.
CO4. learn the process of certification of organic produce.
CO5. analyse the steps in preparation and quality analysis of enrich compost, vermi compost and bio-fertilizers/bio-inoculants.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2				
CO2					1							
CO3		3										
CO4												1
CO5											2	

UNIT-I (4 Hours)

Principles and scope of organic farming in India; Initiatives taken by Government (central and state), NGOs and other organizations for promotion of organic agriculture. Organic farming - concept and definition, its relevance to India and global agriculture and future prospects. Organic production requirements. Biological intensive nutrient management. Recycling of organic residues. Soil improvement and amendments.

UNIT-II (5 Hours)

Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming. Soil fertility- nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermi compost, green manures and bio fertilizers. Farming systems, crop rotations, intercropping in relation to maintenance of soil productivity.

UNIT-III (3 Hours)

Fundamentals of insect- pests, diseases and weed management under organic mode of production; Operational structure of National Programme for Organic Production (NPOP);

UNIT-IV (3 Hours)

Certification process and standards of organic farming; Processing, labelling, economic considerations, viability, marketing and export potential of organic products.

Recommended Text Books / Reference Books:

1. Arun K. Sharma. 2002. A Hand book of organic farming. Agrobios, India. 627p.
2. Palaniappan, S.P and Annadurai, K.1999. Organic farming-Theory and Practice. Scientific publishers, Jodhpur,India. 257p.
3. Mukund Joshi and Prabhakarasetty, T.K. 2006. Sustainability through organic farming. Kalyani publishers, New Delhi. 349p.
4. Balasubramanian, R., Balakishnan, K and Siva Subramanian, K. 2013. Principles and practices of organic farming. Satish Serial Publishing House. 453p 39
5. Tarafdar, J.C., Tripathi, K.P and Mahesh Kumar, 2009. Organic agriculture. Scientific Publishers, India. 369p.
6. Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. 2010. Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur. 420p.
7. Dushyent Gehlot. 2005. Organic farming- standards, accreditation, certification and inspection. Agrobios, India. 357p

Farm Management, Production & Resource Economics

Subject Code: BAGRS1-658	L	T	P	C	Duration: 15 (Hrs.)
	1	0	0	1	

Course Objective: The specific objectives of this course is to make the students able to:
1. know the concept of farms and principles of farm management, objectives, types and characteristics, various laws and relationship between different factors and products.
2. understand the cost concept, farm business, and technical and economic efficiency analysis of various enterprises, farm records, and linear programming.
3. comprehend the risk and uncertainty in agriculture, crop insurance, resource economics, externalities and management of common property resources.

Course Outcomes: Students will be able to:
CO1. gain knowledge about comprehensive treatment of the traditional agricultural production economics topics
CO2. focus on the neoclassical factor-product, factor-factor and product- product models
CO3. understand limited resources available in the economy
CO4. know about availability of rich natural endowments to achieve sustainable agricultural development
CO5. gain knowledge of the causes of regional variations in productivity and production, social and economic inequality, size of land holdings and lack of quality inputs etc.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2			
CO2							1					
CO3					3							
CO4			2									
CO5										1		

UNIT-I (4 Hours)

Agricultural Production Economics: definition, nature and scope. Laws of returns. Factor product relationship: determination of optimum input and output. Farm management: meaning, definition and importance.

UNIT-II (3 Hours)

Economic principles applied to the organizations of farm business. Types and systems of farming. Farm planning and budgeting. Risk and uncertainty. Agricultural finance: nature and scope, compounding and discounting.

UNIT-III (5 Hours)

Agricultural credit: meaning, definition, need and classification. Credit appraisal. History of financing agriculture in India. Agricultural Financial Institutions. Assessment of crop losses. Determination of compensation.

UNIT-IV (3 Hours)

Crop insurance. Agricultural Cooperation- philosophy and principles, History of Indian Cooperative Movement. Cooperative credit structure and reorganization of cooperative credit structure and single window system.

Recommended Text Books / Reference Books:

1. V.T. Raju, D.V.S Rao. Economics of Farm Production and Management
2. Bishop, C.E. and W. D. Tousaint. 1958. Introduction to Agricultural Economic Analysis. John Wiley and Sons, London.
3. Heady, Earl O. 1964. Economics of Agricultural Production and Resource Use. Prentice Hall of India, Private Limited, New Delhi
4. S.S. Johl, J.R. Kapur. 2006. Fundamentals of Farm Business Management.
5. Kahlon, A.S. and Karam Singh. 1965. Principles of Farm Business Management. Kalyani Publishers, New Delhi.
6. Raju, V.T. and D.V.S. Rao. 2006. Economics of Farm Production and Management. Oxford & IBH Publishing Co. Pvt. Limited, New Delhi

Principles of Food Science and Nutrition

Subject Code: BAGRS1-659	L T P C 2 0 0 2	Duration: 30 (Hrs.)

Course Objectives: **The specific objectives of this course are to:**
1. familiarize the students to basic concepts of food science, food composition and food chemistry
2. understand concepts of food microbiology and its use in production of fermented foods
3. develop insights in principles and methods of food processing and preservation.

Course Outcomes:

CO1. critically evaluates information on food science and nutrition issues appearing in the popular press.
CO2. discuss the important pathogen and spoilage microorganism in foods.
CO3. discuss basic principles and practices of cleaning and sanitation in food preparation operation.
CO4. identify and explain nutrients in foods and the specific functions in maintaining health.
CO5. impart knowledge about malnutrition, nutritional disorders; energy metabolism and balanced/ modified diets

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1						
CO2									2			
CO3			3									
CO4							2					
CO5	1											

UNIT-I (9 Hours)

Concepts of Food Science (definitions, measurements, density, phase change, pH, osmosis, surface tension, colloidal systems etc.); Food composition and chemistry (water, carbohydrates, proteins, fats, vitamins, minerals, flavours, colours, miscellaneous bio actives, important reactions). Food and its functions - energy giving, body building, protecting and regulating. Basic food groups.

UNIT-II (6 Hours)

Food microbiology (bacteria, yeast, moulds, spoilage of fresh & processed foods, Production of fermented foods); Principles and methods of food processing and preservation (use of heat, low temperature, chemicals, radiation, drying etc.);

UNIT-III (9 Hours)

Food and nutrition, Malnutrition (over and under nutrition), nutritional disorders. Nutrients, their functions, sources and deficiency diseases - proteins, carbohydrates, lipids, vitamins - fat soluble and water soluble, minerals. Concept of balanced diet. Recommended Dietary Allowances (RDA) for various age groups according to their physiological status for specific nutrients and energy.

UNIT-IV (6 Hours)

Energy metabolism (carbohydrates, fats, proteins); Balanced/modified diets, Menu planning, New trends in food science and nutrition. Water and electrolyte balance - functions and distribution in body. Basal metabolism - methods of measurement and factors affecting BMR.

Nutrition, infection and immunity. Nutritional status using dietary survey, anthropometry, clinical signs and biochemical methods. Nutrition education, nutrition policies and their implementation. Non-conventional foods and their use.

Recommended Text Books / Reference Books:

1. P.H.Pandey. Principles & Practices of Post Harvest Technology
2. D.V. Reedy. Applied Nutrition
3. Sumati R. Mudambi, Shalini M. Rao and M.V. Rajagopal. 2006. Food Science, 2nd Ed. New Age International (P) Limited, New Delhi.
4. Martin Eastwood. 2003. Principles of Human Nutrition. Blackwell Science Ltd., Oxford.
5. Norman N. Potter. 1998. Food Science, 5th Ed. Springer Science+ Business Media, New York.
6. Michael J. Pelczar Jr., E.C.S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGraw-Hill Education, New Delhi.
7. William C. Frazier and & Dennis C. Westfoff. 1987. Food Microbiology, 4th Ed. Tata McGraw-Hill Education, New Delhi.
8. L.E. Casida Jr. 1968. Industrial Microbiology. New Age International Publishers, New Delhi.

9. P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.
10. Marcus Karel and Darvl B. Lund.2003. Physical Principles of Food Preservation, 2nd Ed. Marcel Dekker, Inc., NY, USA.
11. Gerald Wiseman. 2002. Nutrition and Health. Taylor & Francis, London.

Rainfed Agriculture & Watershed Management Lab

Subject Code: BAGRS1-660 | **L T P C** 0 0 2 1 | **Duration: 30 (Hrs.)**

Course Objectives: The specific objectives of this course are to make the students able to:
1. identify several plant diseases and pathogens.
2. identify of various pests' and pathogens' life cycles for the purpose of management measures.
3. develop various IPM techniques to control pests and diseases without contaminating the soil, water or environment.

Course Outcomes: Students will be able to:
CO1. detect the different pathogens and diseases in plants.
CO2. identify life cycle of different pests and pathogens for control measures.
CO3. make different IPM strategies so that the pests and diseases can be controlled without soil, water and environment pollution.
CO4. make use of rainfall water for a larger area by suitable watershed management techniques.
CO5. conserve soil by adopting latest soil conservation techniques.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2						
CO2	3											
CO3									1			
CO4				1								
CO5					2							

PRACTICALS

Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures.

Protected Cultivation and Secondary Agriculture Lab

Subject Code: BAGRS1-661 | **L T P C** 0 0 2 1 | **Duration: 30 (Hrs.)**

Course Objectives :- The specific objectives of this course are to:

1. understand the infrastructure of greenhouse system.
2. recognise the different properties of produce influenced by environment.
3. aware about the various equipment's used in greenhouse system.

Course Outcomes: - Students will able to:

CO1. learn about the ventilation techniques used in greenhouse.

CO2. handle different agricultural tools.

CO3. know different post - harvest handling techniques.

CO4. know the different methods of available moisture techniques.

CO5. learn about Irrigation systems used in greenhouses, shade net house in protected cultivation.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										1		
CO2						3						
CO3									2			
CO4												1
CO5				2								

PRACTICALS

Study of different type of greenhouses. Determine the rate of air exchange in an active summer winter cooling system. Determination of drying rate of agricultural products inside greenhouse. Study of greenhouse equipments. Visit to various Post Harvest Laboratories. Determination of Moisture content of various grains by oven drying, moisture meter and infrared moisture methods. Determination of engineering properties (shape and size, bulk density and porosity of biomaterials). Field visit to seed processing plant/ protected cultivation center.

Diseases of Field and Horticultural Crops and their Management-II Lab

Subject Code: BAGRS1-662 | **L T P C** 0 0 2 1 | **Duration: 30 (Hrs.)**

Course Objectives: The specific objectives of this course are to:

1. understand the signs, causes, progression, and control of disease in a variety of field and horticultural

crops.
2. recognise, evaluate and manage of specific field crops and horticulture.
3. compare the means of dispersal of these diseases.

Course Outcomes: Students will be able to:
CO1. learn about the typical organisms causing various ailments.
CO2. learn the causes and symptoms of various illnesses so that you can diagnose diseases in horticultural and field crops.
CO3. learn means of dispersal of these diseases suitable management methods can be applied.
CO4. learn how to use management techniques that are both environmentally benign and economically viable.
CO5. know the various chemical control techniques.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3									
CO2						1						
CO3		2										
CO4				2								
CO5			1									

PRACTICALS

Identification and histopathological studies of selected diseases of field and horticultural crops. Field visit to Govt. fruit nurseries and orchards for the diagnosis of field problems. Collection and preservation of plant diseased specimens for herbarium.

Post-harvest Management and Value Addition of Fruits and Vegetables Lab

Subject Code: BAGRS1-663 **L T P C** **Duration: 30 (Hrs.)**
0 0 2 1

Course Objectives: **The specific objectives of this course are to:**

1. understand the importance of post-harvest management and processing of fruits and vegetables.

2. impart knowledge about chilling and freezing injury in vegetables and fruits.

3. evaluate the quality of the products.

Course Outcomes: Students will be able to:
CO1. learn applications of packaging and increasing shelf life of fruits and vegetables.
CO2. study the effect of different factors on the shelf life of products.
CO3. handle the tool and equipment design for PHT (Post harvest technology) and value addition.
CO4. prepare different products from fruits and vegetables.
CO5. evaluate the quality of products.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					1							

CO2									2			
CO3		3										
CO4				3								
CO5					2							

PRACTICALS

Applications of different types of packaging, containers for shelf life extension. Effect of temperature on shelf life and quality of produce. Demonstration of chilling and freezing injury in vegetables and fruits. Extraction and preservation of pulps and juices. Preparation of jam, jelly, RTS, nectar, squash, osmotically dried products, fruit bar, candy, tomato products and canned products. Quality evaluation of products -- physico-chemical and sensory. Visit to processing unit/industry.

Management of Beneficial Insects Lab

Subject Code: BAGRS1-664 **L T P C** **Duration: 30 (Hrs.)**

0 0 2 1

Course Objectives: The specific objectives of this course are to:

1. learn the importance of beneficial insects.
2. study the biology of bee, silkworm and lac insect, morphology of host plants and their pest and diseases.
3. study different rearing methods and management practices of bee keeping, mulberry and lac cultivation.

Course Outcomes: Students will be able to:

CO1. practice apiculture, sericulture and lac culture as an entrepreneur according to agro climatic zone.
CO2. understand commercial methods of rearing, equipment, seasonal management, insect pest and disease.
CO3. make the use of different bio control agents (Predator, Parasite and Parasitoids) for sustainable pest management.
CO4. learn about mass multiplication technique of biological control agents and established a bio control lab in future as an entrepreneur.
CO5. study different species of bees, silkworm and lac insect for commercial use.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2									
CO2			1									
CO3				2								
CO4					3							
CO5						1						

PRACTICALS

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and diseases. Bee pasturage, bee foraging and communication. Types of silkworm, voltinism and biology of silkworm. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Species of lac insect, host plant identification. Identification of other important pollinators, weed killers and scavengers. Visit to research and training institutions devoted to beekeeping/ sericulture/ lac culture. Identification and control of natural enemies.

Crop Improvement-II *(Rabi crops)* Lab

Subject Code: BAGRS1-665 **L T P C** **Duration: 30 (Hrs.)**

0 0 2 1

Course Objectives: The specific objectives of this course are to:

1. know the centres of origin, distribution and related species of rabi crops.
2. know the different qualitative and quantitative traits of rabi crops.
3. understand different hybridization techniques of different rabi crops.

Course Outcomes: Students will be able to:

CO1. know handling techniques of rabi crops.
CO2. learn the gene preservation methods.
CO3. recognise genetic variability and seed vigour.
CO4. study the different field techniques for hybrid seed production.
CO5. learn the in-situ conservation of genetic traits of crops.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2							
CO2			2									
CO3							1					
CO4		1										
CO5					3							

PRACTICALS

Floral biology, emasculation and hybridization techniques in different crop species namely Wheat, Oat, Barley, Chickpea, Lentil, Field pea, Rajma, Horse gram, Rapeseed Mustard, Sunflower, Safflower, Berseem and Sugarcane; Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed descent methods; Study of field techniques for seed production and hybrid seed production in Rabi crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, study of donor parents for different characters; Visit to seed/ hybrid seed production research station.

Principles of Organic Farming Lab

Subject Code: BAGRS1-666 **L T P C** **Duration: 30 (Hrs.)**

0 0 2 1

Course Objectives: The specific objectives of this course are to:

1. to understand concepts and principles of organic farming.

2. know about Organic ecosystem and Organic nutrient resources and its fortification.
3. make the right choice of crops and varieties in organic farming and to avoid the use of chemical/inorganic inputs for management of insect, pest, disease and weed.

Course Outcomes: Students will be able to:
CO1. make proper use of initiatives taken by Government for organic produce.
CO2. evaluate the role of NGOs in producing organic products.
CO3. prepare different composts organic in nature.
CO4. analyse the different quality parameters of organic product.
CO5. handle and manage the organic produce.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2									
CO2					2							
CO3		3										
CO4				3								
CO5			1									

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling of organic produce.

Farm Management, Production & Resource Economics Lab

Subject Code: BAGRS1-667 **L T P C** **Duration: 30 (Hrs.)**

0 0 2 1

Course Objectives: The specific objectives of this course are to:

1. select profitable enterprises combinations.

2. make decisions regarding farm budgets and farm records.

3. collect and analyse data from various resources.

Course Outcomes: Students will be able to:
CO1. understand farm layout plans.
CO2. know about farm assets and cost benefit ratio.
CO3. become aware about utilisation of limited resources available at the farm.
CO4. use eco -friendly resources to achieve sustainable agricultural development.
CO5. gain knowledge about the seasonal variations in the production and productivity.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											3	

CO2	2											
CO3								1				
CO4	2											
CO5				1								

Practical

Preparation of farm layout. Determination of cost of fencing of a farm. Computation of depreciation cost of farm assets. Determination of most profitable level of inputs use in a farm production process. Determination of least cost combination of inputs. Selection of most profitable enterprise combination. Application of cost principles including CACP concepts in the estimation of cost of crop and livestock enterprises. Preparation of farm plan and budget, farm records and accounts and profit & loss accounts. Collection and analysis of data on various resources in India.

Hi-tech Horticulture

Subject Code: BAGRD1-671 | **L T P C** 2 0 0 2 | **Duration: 30 (Hrs.)**

Course Objectives: The specific objectives of this course are to:

1 impart knowledge of mechanization, micro propagation and protected cultivation of horticultural crops
2 develop understanding of application of precision farming in horticultural crop
3 analyse the greenhouses based on shape, utility, construction, covering materials and cost.

Course Outcomes: Students will be able to:

CO1. deal with seed production technology of horticultural crops.
CO2. study Plant Propagation and Nursery Management.
CO3. learn importance & scope of hi-tech horticulture in India.
CO4. manage Hi-tech nursery & mechanization of horticultural crops.
CO5. learn Protected cultivation: advantages & constraints.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									1			
CO2					2							
CO3		2										
CO4										2		
CO5						1						

UNIT-I (7 Hours)

Introduction & importance; Nursery management and mechanization; micro propagation of horticultural crops.

UNIT-II (7 Hours)

Modern field preparation and planting methods, Protected cultivation: advantages, controlled conditions, method and techniques.

UNIT-III (6 Hours)

Micro irrigation systems and its components; EC, pH based fertilizer scheduling, canopy management, high density orcharding.

UNIT-IV (10 Hours)

Components of precision farming: Remote sensing, Geographical Information System (GIS), Differential Geo-positioning System (DGPS), Variable Rate applicator (VRA), application of precision farming in horticultural crops (fruits, vegetables and ornamental crops); mechanized harvesting of produce.

Recommended Text Books/ Reference Books:

1. T. A. More, Karale A. R. and Patil M.T. 2001. Hi-tech Horticulture, CAFT (Fruits), MPKV, Rahuri.

2. Balraj Singh.2005. Protected cultivation of vegetable crops, Kalyani Publishers, New Delhi.

3. Patil, M.T and Patil, P.V. 2004. Commercial Protected Floriculture, MPKV, Rahuri

4. Commercial Floriculture – Prasad & Kumar.

5. Proceedings of International seminar on protected cultivation in India, held at Bangalore (1997)

6. Greenhouse operation and management- Paul. V. Nelson

Hi-tech. Horticulture Lab

Subject Code: BAGRD1-675 **L T P C** **Duration: 30 (Hrs.)**

0 0 2 1

Course Objectives: The specific objectives of this course are to:

1. understand different micro-propagation techniques of horticultural crops.

2. develop and understanding of precision farming in horticultural crops.

3. understand the utility, construction material and cost of green house.

Course Outcomes: Students will be able to:

CO1. deal with seed production technology of horticultural crops.
CO2. study plant propagation and nursery management.
CO3. learn importance & scope of hi-tech horticulture in India.
CO4. manage Hi-tech nursery & mechanization of horticultural crops.
CO5. learn Protected cultivation: advantages and limitations.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					1							
CO2		3										

CO3								2				
CO4				1								
CO5							1					

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipments identification and application, Micro propagation, Nursery-protrays, micro-irrigation, EC, pH based fertilizer scheduling, canopy management, visit to hi-tech orchard/nursery.

Agricultural Journalism

Subject Code: BAGRD1-672 **L T P C** **Duration: 30 (Hrs.)**

2 0 0 2

Course Objectives: The specific objectives of this course are to:

1. impart learning of different kinds of communication media
2. learn gathering agricultural information and writing stories
3. impart the knowledge of Mass communication & Journalism covering a wide areas of studies.

Course Outcomes: Students will be able to:

CO1. get knowledge about mass communication & journalism covering a wide areas of studies.
CO2. grasp the concepts of communication, its role and importance in society.
CO3. learn about skills related to Information Communication Technologies (ICTs)
CO4. know the objectivity and critical thinking for communicating to masses through a variety of mediums
CO5. become an enlightened citizen as well as a dynamic professional with commitment to deliver one's responsibilities strictly adhering to highest standard of ethics and professionalism.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1									
CO2						2						
CO3									3			
CO4												1
CO5				2								

UNIT-I (8 Hours)

Agricultural Journalism: The nature and scope of agricultural journalism, characteristics and training of the agricultural journalist, how agricultural journalism is similar to and different from other types of journalism.

UNIT-II (8 Hours)

Newspapers and magazines as communication media: Characteristics; kinds and functions of newspapers and magazines, characteristics of newspaper and magazine readers. Form and content of newspapers and magazines: Style and language of newspapers and magazines, parts of newspapers and magazines.

UNIT-III (7 Hours)

The agricultural story: Types of agricultural stories, subject matter of the agricultural story, structure of the agricultural story. Gathering agricultural information: Sources of agricultural information, interviews, coverage of events, abstracting from research and scientific materials, wire services, other agricultural news sources.

UNIT-IV (7 Hours)

Writing the story: Organizing the material, treatment of the story, writing the news lead and the body, readability measures. Illustrating agricultural stories: Use of photographs, use of artwork (graphs, charts, maps, etc.), writing the captions. Editorial mechanics: Copy reading, headline and title writing, proofreading, lay outing.

Recommended Text Books/ Reference Books:

1. Arvind Kumar (1999). The Electronic Media. Anmol Publications, New Delhi.
2. Bhatt, S.C. (1993) Broadcast Journalism. Basic Principles Har Anand Publications, Delhi.
3. Bhatnagar, R. (2001). Print Media and Broadcast Journalism. Indian Publisher Distributors, Delhi
4. Katyal, V.P (2007). Fundamentals of Media Ethics. Cyber Tech Publishers, New Delhi.
5. Yadava, J.S and Mathur, P. (1998). Issues in Mass Communication: the basic concepts. Volumes 1 and 2. Indian Institute of Mass Communication, New Delhi.

Agricultural Journalism Lab

Subject Code: BAGRD1-676	L T P C	Duration: 30 (Hrs.)
	0 0 2 1	

Course Objectives: The specific objectives of this course are to:

1. teach students about many forms of communication
2. learn how to write facts and get knowledge about agriculture
3. spread information about journalism and mass communication throughout several fields of study.

Course Outcomes: Students will be able to:

CO1. learn about journalism and mass communication in a variety of fields of study.

CO2. comprehend the ideas behind communication, as well as its significance in society.

CO3. study ICT-related skills.

CO4. communicate with the public effectively through a number of media by being objective and critical-thinking.

CO5. become a dynamic professional with a commitment to carrying out one's duties while adhering to the highest standards of integrity and competence.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2			
CO2						2						
CO3					3							
CO4			1									
CO5							2					

Practical

Practice in interviewing. Covering agricultural events. Abstracting stories from research and scientific materials and from wire services. Writing different types of agricultural stories. Selecting pictures and artwork for the agricultural story. Practice in editing, copy reading, headline and title writing, proof-reading, layouting. Testing copy with a readability formula. Visit to a publishing office.

Food Safety And Standards

Subject Code: BAGRD1-673 **L T P C** **Duration: 30 (Hrs.)**

2 0 0 2

Course Objectives: The specific objectives of this course are to:

1. know about the food safety and its various standards.
2. ensure that food is safe and is handled safely, as well as to ensure the health-related quality of food and that its quality in other respects accords with the food regulations
3. protect the consumer from health hazards and financial losses caused by foods that violates the food regulations

Course Outcomes: Students will be able to:

CO1. understand the food safety, hazards and risks, types of hazards - biological, chemical, physical hazards.
CO2. gain knowledge about food storage, hygiene and sanitation.
CO3. understand food laws and standards Indian food regulatory regimes.
CO4. explain importance of nutrients in food and the specific functions in maintaining health.
CO5. discuss the important pathogen and spoilage microorganism in foods.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												1
CO2										1		
CO3							2					
CO4				1								
CO5												2

UNIT-I (8 Hours)
Food Safety – Definition, Importance, Scope and Factors affecting Food Safety. Hazards and Risks, Types of hazards - Biological, Chemical, Physical hazards. Management of hazards - Need. Control of parameters. Temperature control. Food storage. Product design.
UNIT-II (8 Hours)
Hygiene and Sanitation in Food Service Establishments- Introduction. Sources of contamination and their control. Waste Disposal. Pest and Rodent Control. Personnel Hygiene. Food Safety Measures. Food Safety Management Tools- Basic concepts. PRPs, GHPs, GMPs, SSOPs etc. HACCP. ISO series.
UNIT-III (7 Hours)
TQM- concept and need for quality, components of TQM, Kaizen. Risk Analysis. Accreditation and Auditing, Water Analysis, Surface Sanitation and Personal Hygiene. Food laws and Standards- Indian Food Regulatory Regime, FSSA. Global Scenario CAC. Other laws and standards related to food. Recent concerns- New and Emerging Pathogens.
UNIT-IV (7 Hours)
Packaging, Product labelling and Nutritional labelling. Genetically modified foods\ transgenic. Organic foods. Newer approaches to food safety. Recent Outbreaks. Indian and International Standards for food products.

Recommended Text Books/ Reference Books:

1) Food Microbiology. W.C. Frazier and D.C. Westhoff, 4th Edn. Tata McGraw-Hill Publishing Company Limited, New Delhi.

2) Food Safety Handbook. Ronald H. Schmidt and Gary E. Rodrick. 2003. John Wiley & Sons, Inc., Hoboken. New Jersey, USA.

3) Food Safety and Food Quality. R.E. Hester and R.M. Harrison. 2001. Royal Society of Chemistry, Cambridge, UK.

4) The Safety of Foods (Sicherheit von Lebensmitteln). GrahamGraham, H. D. (Edit.) 2.

5) Auflage. AVI Publishing Co., Inc., Westport, Connecticut (USA)

6) Food Chemistry (New Edition).Owin R. Fenema

7) Handbook of Food Toxicology. S.S. Deshpande, CRC Press. 2002.

8) Food Hygiene and Sanitation. S. Roday,Tata McGraw-Hill Education

9) Food Microbiology. M.R. Adams and M.O. Moss

10) Food Quality Assurance: Principles and Practices. Inteaz Alli. 2004. CRC Press, Boca Raton, FL, USA.

11) Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices.Michael M. Cramer. 2013. CRC Press, Boca Raton, FL, USA.

12) Regulatory status of Direct Food Additives. Furia TE.1980. CRC Press.

16) Sensory Evaluation of Food - Theory and Practice. Jellinek G. 1985. Ellis Horwoood.

18) Quality Control in Food Industry. Krammer A & Twigg BA.1973.Vol.I, II. AVI Publ.

Food Safety And Standards Lab

Subject Code: BAGRD1-677	L T P C	Duration: 30 (Hrs.)
	0 0 2 1	

Course Objectives: The specific objectives of this course are to:

1. know about food safety and its varied standards.

2. Ensure the health-related quality of food, that it is handled properly, and that its quality in all other regards complies with food rules.

3. safeguard consumers from health risks and financial losses brought on by eating food that doesn't comply with food regulations

Course Outcomes: Students will be able to:

CO1. analyse the different physio-chemical properties of water.

CO2. learn about cleanliness, hygiene, and food storage.

CO3. knowledge of food laws and regulations Indian laws governing food.

CO4. emphasise the significance of nutrients in food and their specialised roles in supporting health.

CO5. learn about the pathogens and bacteria that cause food to deteriorate.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3						
CO2	1											
CO3									1			
CO4				3								
CO5					2							

Practical

Water quality analysis physio-chemical and microbiological. Preparation of different types of media. Microbiological Examination of different food samples. Assessment of surface sanitation by swab/rinse method. Assessment of personal hygiene. Biochemical tests for identification of bacteria. Scheme for the detection of food borne pathogens. Preparation of plans for Implementation of FSMS - HACCP, ISO: 22000.

Agri-business Management

Subject Code: BAGRD1-674 | **L T P C** 2 0 0 2 | **Duration: 30 (Hrs.)**

Course Objectives: The specific objectives of this course are to:

1. know about the concepts of agribusiness and agro-based industries.
2. understand primary and supportive activities and different management functions.
3. comprehend financial statements and marketing Management.

Course Outcomes: Students will be able to

CO1. know the concept of agribusiness and agro-based industries.

CO2. understand primary and supportive activities and different management functions.
CO3. analyse Financial statements and Marketing Management.
CO4. evaluate Product Life Cycle (PLC) and project cycle.
CO5. analyse Product Life Cycle (PLC) and project cycle.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		1										
CO3				3								
CO4			2									
CO5						1						

UNIT-I (8 Hours)

Nature and scope of agribusiness. Evolution and changing dimensions of agribusiness in India with special reference to Punjab. Characteristics of production, consumption and marketing of agricultural surplus. Processing of agricultural output.

UNIT-II (8 Hours)

Entrepreneurship in agribusiness. Types and patterns of organization in agribusiness. Principles of management and application in agribusiness enterprises. Locational factors and various other problems faced by agro industrial and other enterprises related with agribusiness. Business environment: PEST & SWOT analysis. Management functions: Roles & activities, Organization culture.

UNIT-III (7 Hours)

Planning, meaning, definition, types of plans. Purpose or mission, goals or objectives, Strategies, polices procedures, rules, programs and budget. Components of a business plan, Steps in planning and implementation. Organization staffing, directing and motivation. Ordering, leading, supervision, communications, control. Capital Management and Financial management of Agribusiness. Financial statements and their importance.

UNIT-IV (7 Hours)

Marketing Management: Segmentation, targeting & positioning. Marketing mix and marketing strategies. Consumer behaviour analysis, Product Life Cycle (PLC). Sales & Distribution Management. Pricing policy, various pricing methods. Project Management; project cycle, identification, formulation, appraisal, implementation, monitoring and evaluation. Project Appraisal and evaluation techniques.

Recommended Text Books/ Reference Books:

1) Agribusiness Management by Dr. Shivaji Nagpure & Dr. R.G. Deshmukh, M/s. AGROMET Publishers, Nagpur.

2) Indian Agriculture & Agri-Business Management by Dr. Smita Diwase, M/s. Scientific Publishers, Jodhpur, Rajasthan.

3) Agricultural Finance & Management by S. Subha Reddy, & P. Raghu Ram, M/s. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.

4) Agri Business Management by Dr. J.S. Amarnath & Dr. A.P.V. Samvel, M/s. Satish Serial Publishing House, Delhi-110033.

5) The Agribusiness Book by Mukesh Pandey, Deepali Tewari, M/s. ibdc Publishers, Lukhnow (U.P.), Pin-226 001.

6) Economics analysis of Agricultural Projects by J. Price Gittinger, M/s. The Economics Development Institute/World Bank, Washington D.C.-20433, U.S.A.

Agri-business Management Lab

Subject Code: BAGRD1-678 | **L T P C** 0 0 2 1 | **Duration: 30 (Hrs.)**

Course Objectives: The specific objectives of this course are to:

1. learn the concepts of agribusiness and agro-based industries.
2. study the functions and benefits of different financing institutions.
3. study the trends in prices of agricultural commodities.

Course Outcomes: Students will be able to:

CO1. know the concept of agribusiness and agro-based industries.
CO2. understand primary and supportive activities and different management functions.
CO3. analyse Financial statements and Marketing Management.
CO4. understand the scenario of market.
CO5. analyse Product Life Cycle (PLC) and project cycle.

Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2							
CO2		1										
CO3								3				
CO4			2									
CO5				1								

Practical

Study of agri-input markets: Seed, fertilizers, pesticides. Study of output markets: grains, fruits, vegetables, flowers and value added products. Study of financing institutions- Cooperative, Commercial banks, RRBs, Agribusiness Finance Limited, NABARD. Preparations of projects and Feasibility reports for agribusiness entrepreneur. Appraisal/evaluation techniques of identifying viable project. Case study of agro-based industries. Trend and growth rate of prices of agricultural commodities. Viable of a project: IRR, NPW and payback criteria.

Total Contact Hours= 27 **Total Marks= 700** **Total Credits= 23**

1st Semester		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCHMS1-101	Electronic Spectra & Magnetic Properties of Transition Metal Complexes	4	0	0	40	60	100	4
MCHMS1-102	Organic Reactions & Mechanisms-I	4	0	0	40	60	100	4
MCHMS1-103	Thermodynamics& Solid State	4	0	0	40	60	100	4
Departmental Elective-I (Choose any one)		4	0	0	40	60	100	4
MCHMD1-111	Computational Skills & Simulations in Chemistry							
MCHMD1-112	Polymer Chemistry							
MCHMD1-113	Chemical Kinetics & Electrochemistry							
Open Elective		3	0	0	40	60	100	3
MCHMS1-104	Inorganic Chemistry Lab.-I	0	0	4	60	40	100	2
MCHMS1-105	Organic Chemistry Lab.-I	0	0	4	60	40	100	2
	Total	**19**	**0**	**08**	**320**	**380**	**700**	**23**

ELECTRONIC SPECTRA & MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES

Subject Code: MCHMS1-101 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives

1. To understand the concept of symmetry elements and symmetry operations.
2. To provide fundamental knowledge of inter electronic repulsion parameters and crystal field strength in various fields.
3. To give knowledge of the Orgel and correlation diagrams.
4. To understand molecular orbital diagrams for octahedral and tetrahedral diagrams

Course Outcomes:
The completion of this course will make student to acquire the knowledge of:

1. Interpretation of electronic and magnetic properties.
2. Interpretation of molecular orbital diagrams of octahedral and tetrahedral diagrams for various electronic properties.
3. Concepts of symmetry and group theory in solving chemical structural problems.
4. Use of character tables and application of group theory in spectroscopy.

UNIT-I **(13 Hrs.)**

1. Symmetry
Symmetry elements, symmetry operations, point group determination, determination of reducible and irreducible representations, character tables, use of symmetry in obtaining symmetry of orbitals in molecules qualitative splitting of s, p, d, f orbitals in octahedral, tetrahedral and square planar fields using character tables and without the use of character tables.

UNIT-II **(7 Hrs.)**

2. Inter Electronic Repulsions
Spin-spin, orbital-orbital and spin orbital coupling, L.S. and jj coupling schemes, determination of all the spectroscopic terms of p^n , d^n ions, determination of the ground state terms for p^n , d^n , f^nions using L.S. scheme, determination of total degeneracy of terms, order of inter electronic repulsions and crystal field strength in various fields, two type of electron repulsion parameters, term wave functions, spin orbit coupling parameters (λ) energy separation between different j states

3. Free Ions in Crystal Field of various Strengths **(10 Hrs.)**
The effect of Voct on S, P, D and F terms (with help of the character table), Strong field configurations, transition from weak to strong crystal fields, evaluation of strong crystal field terms of d^2 cases in octahedral and tetrahedral crystal fields (using group theory), construction of the correlation energy level diagrams of d^2 configuration in octahedral and tetrahedral fields, study of energy level diagrams for higher configurations, derivation of selection rules of electronic transitions in transition metal complexes, relaxation of the selection rule in centrosymmetric and non-centrosymmetric molecules, Orgel diagrams, Tanabe Sugano diagrams.

UNIT-III (13 Hrs.)

4. Covalent Character into the Metal Ligand Bond

Construction of Molecular orbital energy level diagrams for octahedral, tetrahedral and square planar complexes showing σ and π bonding. Transformation properties of atomic orbitals, molecular orbitals for sigma and pi bonding in tetrahedral and octahedral molecules.

UNIT-IV (9 Hrs.)

5. Electronic Spectra of Transition Metal Complexes

Spectrochemical series, band intensities, factors influencing band widths (variation of 10Dq, vibrational structure, spin orbit coupling, low symmetry components, Jahn-Teller effect), discussion of electronic spectra of octahedral and tetrahedral $d^1 – d^9$ metal ions, calculation of 10Dq and B with and without the use of Tanabe Sugano diagrams, low spin complexes of Mn^{3+}, Mn^{2+}, Fe^{3+}, Co^{3+}, Fe^{2+}, comment on the spectra of second and third transition series, Charge Transfer spectra, comparison of d – d band with f –f spectra.

6. Magnetic Properties (8 Hrs.)

General discussion about magnetism in metal complexes (magnetic susceptibility, para-, dia-, ferro-, antiferro- and ferri-magnetic behavior, Curie and Curie Weiss law, magnetic properties of *d* block transition metal ions for d^1 to d^9 configuration, quenching of orbital magnetic moment, spin only magnetic moment, first order orbital contribution to the magnetic moment, orbital contribution due to spin –orbit coupling.

1. B.N. Figgis, 'Introduction to Ligand Field', Wiley Eastern, **1966**.
2. A.B.P. Lever, 'Inorganic Electronic Spectroscopy', Elsevier, **1984.**
3. R. L. Dutta and A. Syamal, 'Elements of Magnetochemistry', East-West Press Pvt. Ltd. Bangalore, **1993**.
4. J.E. Huheey& Others, 'Inorganic Chemistry: Principles of Structure and Reactivity', Harper Inter-Science, **2006.**
5. Russell S. Drago, 'Physical Method for Chemistry', W.B. Saunders Company, **1992**.
6. F.A. Cotton and G. Wilkinson, 'Advanced Inorganic Chemistry', 6th Edn., Wiley Inter- Science, **2004.**
7. F.A. Cotton, 'Chemical Application of Group Theory', 3rd Edn., Wiley Eastern, **2004**.

ORGANIC REACTION AND MECHANISM –I

Subject Code: MCHMS1-102	**L T P C** 4 0 0 4	**Duration: 60 (Hrs.)**

Course Objectives:

1. To familiarize with the methods determining reaction mechanism and various reaction intermediates.
2. To understand the diversity of aliphatic & aromatic nucleophilic and electrophilic reactions.
3. To understand the effect of substrate, leaving group, reaction medium and attacking reagent on substitution and free radical reaction.
4. To acquaint with the named reaction following electrophilic, nucleophilic and free radical mechanism.

Course Outcomes:

The students will be able to:

1. Apprehend the basic concepts of organic reactions and understand mechanism of various reactions including stereochemical, mechanistic and conformational aspects.
2. Assess the reaction condition and the factors affecting the rate of reactions following different mechanisms.
3. Apply their understanding about the organic reactions of industrial significance with respect to chemoselectivity and regioselectivity.

Design new organic compounds and sketch their corresponding feasible reaction pathways..

UNIT-I (15 Hrs.)

1. Reaction Mechanism: Structure and Reactivity

Type of mechanisms, types of reactions, kinetic and thermodynamic control of reactions, Hammond's postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates, methods of determining reaction mechanisms, isotope effects. Hard and soft acids and bases. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.

Effect of structure on reactivity- resonance and field effects, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants.

Stereochemistry: Conformational analysis of Cycloalkanes and Decalins, Effect of conformation on reactivity, Conformation of sugars, Steric-strain due to unavoidable crowding. Elements of symmetry, Chirality, R-S nomenclature, Diastereoisomerism in Acyclic and Cyclic systems, E-Z isomerisms, Interconversion of Fischer, Newman and Sawhorse projections, Molecules with more than one chiral center, Threo and erythro isomers, Methods of resolution, Optical purity,. Optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes), Chirality due to helical shape.

UNIT-II (15 Hrs.)

2. Aliphatic Nucleophilic Substitution

The SN2, SN1, mixed SN1 and SN2 and SET mechanisms.

The neighbouring group mechanism, neighbouring group participation by π- and σ-bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements. Application of NMR spectroscopy in the detection of carbocations. The SN1 mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis and ultrasound, ambident nucleophile, regioselectivity. Gabriel synthesis

3. Aliphatic Electrophilic Substitution

Bimolecular mechanisms- SE2 and SE1. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity, Hell-Volard-Zelinsky reaction.

UNIT-III (15 Hrs.)

4. Aromatic Nucleophilic Substitution

The SNAr, SN1, benzyne and SRN1 mechanisms, Reactivity – effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser, and Smiles rearrangements.

5. Aromatic electrophilic substitution

The arenium ion mechanism, orientation and reactivity in mono substitution and di-substituted aromatics, energy profile diagram, the ortho/para ratio, ipso attack, orientation in other ring systems, quantitative treatment of reactivity in substrates and electrophiles. Diazo coupling, Vilsmeir reaction, Gatterman-Koch reaction, Bechmann reaction, Hoben-Hoesch reaction.

UNIT-IV (15 Hrs.)

6. Elimination Reactions

The E2, E1 and E1cB mechanisms and their spectra. Orientation of the double bond. Reactivity – effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

7. Free Radical Reactions

Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactvity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto- oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Recommended Text Books / Reference Books:

1. Jerry March & Michael Smith, 'March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure', 6th Edn., John Wiley & Sons, **2007.**
2. Francis A. Carey & Richard J. Sundberg, 'Advanced Organic Chemistry: Structure and Mechanisms, Vol, A', 5th Edn., Springer, **2007**.
3. Francis A. Carey & Richard J. Sundberg, 'Advanced Organic Chemistry: Reaction and Synthesis, Vol. B', 4th Edn., Springer, **2006.**

THERMODYNAMICS AND SOLID STATE

Subject Code: MCHMS1-103 | **L T P C** 4 0 0 4 | **Duration: 60 (Hrs.)**

Course Objectives:

1. To recall concepts involved in laws of thermodynamics.
2. To introduce various thermodynamic functions and partition function.
3. To introduce microstates, macrostates and different types of statistics.
4. To familiarise with solid state.

Course Outcomes:

The students will be able to

1. Understand the concept of classical thermodynamics.
2. Understand statistical thermodynamics and thermodynamic properties in terms of partition functions
3. Apply the concept of thermodynamics in a chemical system.
4. Analyze the crystal structure and defects in the crystal.

UNIT-I (20 Hours)

Recall:

First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases under isothermal and adiabatic conditions, Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, Kirchhoff's equations, Second Law: Concept of entropy; statement of the second law of thermodynamics. Calculation of entropy change for reversible and irreversible processes. Free energy and chemical equilibrium. Gibbs-Helmholtz equation; Thermodynamic equation of state. Maxwell relations.

UNIT-II (15 Hours)

Non-ideal Systems:

Excess functions for non-ideal systems. Activity and activity coefficients and their determination. Concept of fugacity and its experimental determination. Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Third Law of the Thermodynamics:

Identification of statistical and thermodynamic entropy. Nernst postulate, Plank's contribution. Alternate formulation of third law. Evaluation of absolute entropy. Gibbs equations for non-equilibrium systems. Clausius-Clapeyron equation. Chemical potential of ideal gases. Ideal-gas reaction equilibrium-derivation of equilibrium constant. Temperature dependence of equilibrium constant-the van't Hoff equation.

UNIT-III (15 Hours)

Statistical Thermodynamics:
General introduction, microstates, macrostates, thermodynamic probability. Brief introduction to different types of statistics. Ensemble concept. Canonical, grand canonical and microcanocical ensembles. Maxwell Boltzmann distribution law.

Partition Function and Thermodynamic Properties: Partition function and its factorization. Translational, rotational, vibrational; electronic and nuclear partition functions. Expressions for internal energy, entropy, Helmholtz function, Gibb's function, pressure, work and heat in terms of partition function. Thermodynamic properties of ideal gases. Vibrational, rotational, electronic and nuclear contributions to the thermodynamic properties.

UNIT-IV **(10 Hours)**

Crystal structures: Crystalline and amorphous solids, Crystal size and shapes, Space lattice and unit cell. Bravais lattices, reciprocal lattices, unit cells, Miller indices, Bragg's law, Limiting radius ratio and radius ratio rule, defects in crystals, stoichiometric defects: Shottky defect, Frenkel defect, non-stoichiometric defects: metal excess defect, metal deficiency defect, thermal defects. Line defects: edge dislocation and screw dislocation. Liquid crystals: mesomorphic state, thermotropic mesomorphism, thermography.

Recommended Text Books / Reference Books:

1. Aston and Fritz, 'Thermodynamic and Statistical Thermodynamics', John Wiley & Sons, Inc., 1959.
2. Lee, Sears and Turcotte,'Statistical Thermodynamics', Addison-Wesley Publishing Company 1963.
3. Dickerson, 'Molecular Thermodynamics', Benjamin-Cummings Publishing Company, 1969.
4. Glasstone, 'Thermodynamics for Chemists', EWP,2008.
5. R. C. Srivastva, S. K. Saha, A. K. Jain, 'Thermodynamics: A Core Course', PHI, 2007.
6. P. Atkins, J. D. Paula, 'Physical Chemistry', 7thIndian Edn.,Oxford University Press, 2007.
7. R. P. Rastogi& R. R. Mishra, 'An Introduction to Chemical Thermodynamics',6thEdn., Vikas Publishing House, 2007.

COMPUTATIONAL SKILLS AND SIMULATIONS IN CHEMISTRY

Subject code: MCHMD1-111 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives

1. To learn principles of computational chemistry and computer-based molecular design.
2. To understand the basic concepts of molecular mechanics, semi-empirical method and density-functional theory.
3. To familiarize with different software packages, including MOLDEN for general model building.
4. To understand GAMESS Gaussian for quantum chemical calculations, and BOSS for liquid simulations.

Course Outcomes

The students will acquire knowledge of

1. Advantages and principle of computer based calculation methods in chemistry
2. Fundamentals of various calculation methods viz: molecular mechanics, semi-empirical method and density-functional theory.
3. Running calculation and model building using different algorithms in software packages, like Hyperchem, Gaussian
4. Quantum mechanical calculations in gaseous phase with GAMESS and Liquid simulations in BOSS

UNIT – I **(15 Hrs.)**

1. **OVERVIEW OF THE COURSE**
   Promises of computational chemistry, molecular mechanics of bond vibrations. Minimization methods, forces in polyatomic molecules, intermolecular forces, parameterization and testing of force fields, docking.

2. **MONTE CARLO METHOD (4 Hrs.)**
   Principles, chemical & biochemical applications.

UNIT – II **(15 Hrs.)**

3. **MO THEORY**
   Foundations, semi-empirical MO theory, Ab Initio MO Theory: Basis Sets; Hartree–Fock theory: Principles and applications.

UNIT – III **(15 Hrs.)**

4. **TREATMENT OF ELECTRON CORRELATION**
   MCSCF, CI methods, Treatment of electron correlation: MP and CC methods.

UNIT – IV **(15 Hrs.)**

5. **SPECTROSCOPY**
   Vibrational spectroscopy and gas phase thermodynamics, description of electronically excited states. Description of solvent effects.

6. **DENSITY FUNCTIONAL THEORY (DFT)**
   Principles, applications in materials. Transition states in gas phase reactions.

Recommended Books

1. Peter Comba, Trevor W. Hambley, 'Molecular Modelling of Inorganic Compounds'**,** John Wiley & Sons, **2009**.
2. F. Jensen, 'Introduction to Computational Chemistry'**,** John Wiley & Sons, **1998**.
3. Warren J. Hehre, 'A Guide to Molecular Mechanics and Quantum Chemical Calculations', **2003.**
4. H.D. Holtje, W. Sippl, D. Rognan, G. Folkers, 'Molecular Modeling: Basic Principles and Applications'**,** Wiley, **2008**.
5. Christopher Cramer, 'Essentials of Computational Chemistry, Theories & Models'**,** 2nd Edn., Wiley, **2002**.
6. Note: Freely available packages like GAMESS, MOLDEN, AVOGADOOS, MOPAC may be used for computational Lab.

POLYMER CHEMISTRY

Subject Code: MCHMD1-112 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective

1. To recall concepts involved in polymerization..
2. To introduce various mechanism and kinetics of polymer.
3. To introduce properties and factor affecting the properties of polymers
4. To familiarise with applications of polymer.

Course Outcomes:

The students will be able to

1. concept of polymers and polymer related termnology.
2. To familiarize with concept of kinetics of Polymerization, Morphology of crystalline polymers.
3. Apply the advanced polymer in various field of industries.
4. Analyze the crystal structure of polymer with advanced characterization techniques.

UNIT-I (15 Hrs)

1. INTRODUCTION TO POLYMERS

IUPAC nomenclature of vinyl, non-vinyl polymers, copolymers and end groups. Abbreviations for polymers. Introduction to industrial polymers-plastic thermoplastic-& thermosetting plastics), fibres (commonly used natural & synthetic fibre).

2. POLYMERIZATION MECHANISMS

Mechanism of free radical chain polymerization & ionic chain polymerization-initiators, inhibitors & stereochemistry. Mechanism of coordination chain polymerization (Ziegler-Natta, Cossee), polycondensation step polymerization, polyaddition step polymerization & ring opening step polymerization.

UNIT-II (15 Hrs)

1. KINETICS OF POLYMERIZATION MECHANISMS

Kinetics of free radical chain polymerization, ionic chain polymerization, catalyzed and non-catalyzed polycondensation polymerization including kinetic chain length, chain transfer reactions.

2. AVERAGE MOLECULAR WEIGHT OF POLYMERS

Number average molecular weight – its measurement by osmometry (membrane & vapour phase), end group analysis, mass spectrometry. Weight average molecular weight – its measurement by light scattering method (dissymmetry method & Zimm plot method).

Viscosity average molecular weight – its measurement by viscometry. Determination of molecular weight distribution by gel permeation chromatography (size exclusion chromatography).

UNIT-III (15 Hrs.)

1. CHEMICAL STRUCTURE & POLYMER MORPHOLOGY

Macrostructure of polymers**.** Geometrical isomerism & optical isomerism, Tacticity, degree of crystallinity, liquid crystallinity, crystallizability, crystallites (bundles),spherulites, polymer single (ideal) crystals. Glass transition temperature-concept of glassy state, viscoelastic state, viscofluid state for amorphous and crystalline substances including polymers. Specific volume change vs temperature curves.

a. POLYMER PROPERTIES

Mechanical properties - tensile strength, compressive strength, flexural strength, impact strength, toughness, fatigue, yield point, elongation at break, tensile modulus, relaxation & retardation (creep) phenomena. Thermal stability, flammability & flame resistance, chemical resistance, degradability, electrical conductivity, nonlinear optical properties.

Polymer additives to modify mechanical, surface, chemical, aesthetic & processing properties.

UNIT-IV **(15 Hrs.)**

1. FIBRES REINFORCED POLYMER COMPOSITES

Introduction to composites. Polymer matrix materials & fibres reinforcement. Types of fibres- glass, aramid & silica fibres. Advantages & disadvantages of polymer composites.

2. CHARACTERIZATION TECHNIQUES OF POLYMERS

Infrared, Raman, NMR, ESR, UV-Vis, fluorescence studies. X-ray scattering, SEM, thermal- DSC, DTA, TMA, TGA studies.

Recommended Books

1. D. Campbell and J.R. White, 'Polymer Characterization: Physical Techniques', Chapman and Hall, New York, **1989**.
2. Malcolm P. Stevens, 'Polymer Chemistry: An Introduction', 3rd Edn., Oxford University Press, Indian Edn,, Reprint, **2011**.
3. A.H. Fawcett, 'Polymer Spectroscopy', Wiley, New York, **1996**.
4. R.J. Young, 'Spectroscopy of Polymers', Wiley, New York, **1996**.
5. M. Lewin, S.M. Atlas, E.M. Pearce, 'Flame Retardant Polymeric Materials', Plenum Press, New York, **1975**.
6. E.M. Pearce, Y.P. Khanna, D. Raucher, 'Thermal Characterization of Polymeric Materials', Academic Press, New York,**1981.**
7. I.M. Ward, 'Mechanical Properties of Polymers', Wiley Interscience, New York, **1971**.
8. Jan M. Gooch, 'Encyclopedic Dictionary of Polymers', Springer, **2007**.
9. Anita J. Brandolini, Deborah D. Hills, 'NMR Spectra of Polymers & Polymer Additives', Marcel Dekker, New York, **2000**.
10. Fred W. Wilmeyer, 'Text Book of Polymer Science', A. Wiley Interscìense Publication, 1994.
11. V.R. Gowariker, N.V. Viswanathan, J. Sreedhar; 'Polymer Science', New Age International, **1986**.

CHEMICAL KINETICS AND ELECTROCHEMISTRY

Subject Code: MCHMD1-113 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives:

1. To introduce the concept of activation energy.
2. To introduce various theories of reaction rates.
3. To explain the kinetics of various complex reactions.
4. To introduce various theories of electrolytic solutions and electrolytic conductance.

Course Outcomes:

The students will be able to

1. Compare kinetics of various complex reactions and their rate laws.
2. Apply the concept of activation energy while analysing kinetics of reaction.
3. Connect electrolytic solution and conductance.
4. Appraise the concept of interfacial electrochemistry.

UNIT-I **(18 Hrs.)**

Recall of basic concepts of chemical kinetics, methods of determining rate laws, Arrhenius equation, the concept of activation energy, theoretical calculation of energy of activation, collision and transition state theories of rate constants.
Complex reactions- Opposing reactions, parallel reactions and consecutive reactions (all first order type). Kinetics of chain reactions, steady state approximation; determination of reaction mechanisms; detections of radical and kinetics of HBr, H_2O_2 reactions, explosion limits, The Eyring equation. Unimolecular reactions and Lindemann's theory, application of following to the reaction kinetics: solvent effect, kinetic isotope effect and salt effect, kinetics of acid, base and enzyme catalysis, Hinshelwood mechanism of catalysis.

UNIT-II **(12 Hrs)**

Electron transfer in homogeneous systems, theory of electron transfer processes, electron tunneling, electron transfer in heterogeneous systems, electrode-solution interface, rate of charge transfer in electrode reactions, study of kinetics of electrode processes.

UNIT-III **(15 Hrs)**

Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient. Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law (derivation not required). Calculation of mean ionic activity coefficient. Limitations of Debye-Huckel theory. Extended Debye-Huckel law.
Theory of electrolytic conductance. Derivation of Debye-Huckel-Onsager equation – its validity and limitations.
Concept of ion association – Bjerrum theory of ion association (elementary treatment)-ion association constant – Kohlrausch's law and its applications

UNIT-IV **(15 Hrs)**

Electrochemistry: Nernst equation, redox systems, Chemical and concentration cells (with and without transference). Liquid junction potential (LJP) – derivation of the expression for LJP – its determination and elimination**.** Methods of determining structures of electrified interfaces, Guoy-Chapman, Stern. Types of electrodes. Applications of EMF measurements: Solubility product, potentiometric titrations.
Decomposition potential and its significance. Electrode polarization – its causes and elimination. Concentration over-potential.

Recommended Text Books / Reference Books:

1. P. Atkins, J. D. Paula, 'Physical Chemistry', 7thIndian Edn.,Oxford University Press, 2007.
2. Ira N. Levine, 'Physical Chemistry', McGraw Hill, 2008.
3. D.A. McQuarrie and J.D. Simon, 'Physical Chemistry-A Molecular approach', University Science Books, 1997.
4. J. Rajaraman and J. Kuriacose, 'Kinetics and Mechanism of Chemical Transformations', McMillan, 2011.
5. S. Glasstone, 'Introduction to Electrochemistry', Litton Educational Publishing, 2011.
6. J. O. M. Bockris& A. K. N. Reddy, 'Modern Electrochemistry', Plenum, 1973.
7. E.S. Amis, 'Solvent Effect of Reaction Rates and Mechanism', Academic Press, 1966.
8. K.J. Laidler, 'Chemical Kinetics', McGraw Hill, 1965.

INORGANIC CHEMISTRY LAB-I

Subject Code: MCHMS1-104 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To synthesize inorganic complexes and their characterization.

Course Outcomes:
The students will acquire knowledge of:

1. Volumetric and gravimetric analysis of cations and anions.
2. Understand complexometric and redox titrations.
3. Syntheses of various complexes and their structural analysis

Note:

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.

2. Any other subject related experiment can also be included.

EXPERIMENTS

1. Preparation of coordination compounds, their purification by chromatography and elucidation of structures by physical methods (UV, IR, NMR, magnetic susceptibility etc.)

a. Synthesis of Tris(acetylacetonato)manganese(III), $Mn(acac)_3$ and their characterization.
b. Synthesis and Characterization of Hexamminechromium(III) nitrate $[Cr(NH_3)_6](NO_3)_3$ using magnetic susceptibility balance (MSB) and IR spectroscopy (Green Preparation).
c. Synthesis of Iron(III) dithiocarbamate and its characterization using magnetic succeptibility balance (MSB) and IR spectroscopy.
d. Synthesis and characterization of nitro- and nitritopentamminecobalt(III) chlorides using IR spectroscopy.
e. Synthesis of hexamminecobalt(III) chloride and pentammineaquocobalt(III) chloride.
f. Synthesis of cis- and trans- potassiumdioxalatodiaquochromate(III).

2. Complexometric Titrations

a. Determination of calcium in the presence of magnesium using EDTA as titrant
b. Determination of the total hardness (permanent and temporary) of water
c. Determination of calcium in the presence of barium using EDTA as titrant.

1. Redox Titrations:

a. Determination of chlorate, preparation of 0.1M cerium(IV) sulphate.
b. Determination of copper, determination of dissolved oxygen.

Recommended Books

1. H. Denny, W. Roesky, 'Chemical Curiosites', Wiley VCH,1996.
2. G. Marr and B.W. Rocket, 'Practical Inorganic Chemistry', University Science Books, **1999.**
3. G. Pass and H. Sutcliffe, 'Practical Inorganic Chemistry', 2nd Edn., Chapman and Hall, London, **1974.**
4. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, 'Vogel's Textbook of Quantitative Analysis', 5th Edn., Pearson Education, **2006.**
5. G. Svehla, 'Vogel's Textbook of Quantitative Analysis', Pearson Education, **2006.**
6. Anil J. Elias, 'A Collection of Interesting General Chemistry Experiments', Orient Longman Ltd., Universities Press (India) Pvt. Ltd., **2008**.
7. http://dst.gov.in/green-chem.pdf

ORGANIC CHEMISTRY LAB-I

Subject Code: MCHMS1-105 **L T P C** **Duration: 60 (Hrs.)**
0 0 4 2

Course Objectives

1. To learn the skills of distillation and separation methods
2. To develop experimental skills of various purification techniques.
3. To impart knowledge of detection related to organic functional groups.
4. To execute various organic preparation methods

Course Outcomes:
After the completion of course students will be able to:

1. Carry out distillation and separation methods
2. Identify the TLC of various organic compounds
3. Distinguish and detect organic functional groups
4. Construct various organic preparation methods

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.

2. Any other subject related experiment can also be included.

1. Distillation & Separation
a. To purify common organic solvents
b. Extract rose oil from rose petals by steam distillation.

2. Thin Layer Chromatography (TLC):
a. Identification of phytoconstituents
b. To check TLC purity of Acetaminophen, Aspirin, Caffeine, Phenacetin and Salicylamide after completion of reactions.

3. Organic Analysis:

Detection of common functional groups in the given organic compounds and identification of compounds through derivatives.

4. Organic Preparations:
a. Benzoylation: Hippuric acid
b. Oxidation: Adipic acid/p-Nitrobenzoic acid
c. Aldol condensation: Dibenzalacetone/Cinnamic acid
d. Sandmeyer's reaction:p-Chlorotoluene
e. Benzfused Heterocycles:Benzimidazole
f. Cannizzaro's reaction: p-Chlorobenzaldehyde as substrate

g. Friedel Crafts reaction: S-Benzoylpropionic acid
h. Aromatic electrophilic Substitution:p-Nitroaniline/p-Iodoaniline

Recommended Books

1. David T. Plummer, ‘An Introduction to Practical Biochemistry’, 3rdEdn., TataMcGraw Hills, **1998**.
2. A.I. Vogel, ‘Text Book of Practical Organic Chemistry’, 5thEdn., PearsonEducation, **2005**.
3. P.R. Singh, D.S. Gupta and K.S. Bajpai, ‘Experimental Organic Chemistry’, Vol. 2, Tata McGraw Hill, **1981**.
4. G. Mann, B.C. Saunders, ‘Practical Organic Chemistry’ ELBS Edn,,**1989**.

N.K. Vishnoi, ‘Advanced Practical Organic Chemistry’, 2ndEdn.,Vikas PublishingHouse Pvt. Ltd.,**1994.**

Total Credits= 23

2nd Semester		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCHMS1-201	Molecular Spectroscopy-I	4	0	0	40	60	100	4
MCHMS1-202	Organometallics	4	0	0	40	60	100	4
MCHMS1-203	Organic Reactions & Mechanisms-II	4	0	0	40	60	100	4
MCHMS1-204	Seminar - I	0	0	2	100	--	100	1
Departmental Elective-II (Choose any one)		4	0	0	40	60	100	4
MCHMD1-211	Nano Chemistry							
MCHMD1-212	Bio-organic Chemistry							
MCHMD1-213	Analytical Chemistry							
Departmental Elective-III (Choose any one)		4	0	0	40	60	100	4
MCHMD1-221	Natural Products							
MCHMD1-222	Bio-physical Chemistry							
MCHMD1-223	Asymmetric Synthesis							
MCHMS1-205	Inorganic Chemistry Lab.-II	0	0	4	60	40	100	2
Total		**20**	**0**	**06**	**360**	**340**	**700**	**23**

MOLECULAR SPECTROSCOPY-I

Subject Code: MCHMS1-201 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives:

1. To provide the fundamental knowledge of principles of spectroscopy.
2. To understand the application of spectroscopic concepts.
3. To understand the explanation behind the observed features the spectra of compounds.
4. To give the knowledge of structure elucidation based on spectroscopic data.

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Course Outcomes:

The students will be able to

1. Understand the basic and advanced concepts of spectroscopy.
2. Apply the concepts of spectroscopy to understand the explanation behind the observed features of spectra
3. Analyze and understand the spectra of compounds.
4. Elucidate the structure of molecules on the basis of given spectroscopic data

UNIT-I (15 Hours)

General Features of Spectroscopy

Introduction to spectroscopy, Nature of electromagnetic radiation, Regions of the electromagnetic spectrum Units and conversion factors, Intensities line width and line width broadening of spectral lines, transition probability, transition moment and selection rules

Microwave Spectroscopy

Classification of molecules according to their moment of inertia, Rotational spectra of rigid diatomic molecules, Intensities of spectral lines, isotopic substitution effects. Non-rigid rotator, Polyatomic molecules – Linear and symmetric top molecules, Stark effect

Raman Spectroscopy

Introduction, Classical and Quantam theory of Raman effect, Stokes and antistokes lines, anisotropic polarizability, Pure rotational raman spectra of linear and symmetric top molecules, vibrational raman spectra of H_2O and CO_2 molecules, Polarisation of the light and raman effect, Rule of mutual exclusion

UNIT-II (15 Hours)

Infrared Spectroscopy

Energy of vibrating diatomic molecule, simple harmonic oscillator, force constants, Fundamental vibration frequencies, Anharmonicity of molecular vibrations and its effect on vibrational frequencies, Frequencies of the vibrational transitions of HCl. Vibrational rotation spectra of CO, P, Q and R branches, Vibrations of polyatomic molecules. Examples of CO_2, H_2O, Mechanics of measurement of infrared and Raman spectra, absorption of common functional groups, their dependence onchemical environment (bond order, conjugation, H –bonding), Use of group theory to determine the number of active infrared and Raman active lines. Fermi resonance, combination bands and overtones, Infrared spectrometer, Application of IR in structure elucidation of organic compounds – Various Carbonyl compounds, alkane, alkenes, alkynes, unsubstituted, mono and di-substituted aromatic compounds, alcohols, phenols, ethers, Far IR region, Metal ligand vibrations, – CN, Nitronitrito- and CO ligands and the effect of their co-ordination with metal ions and IR spectra.

UNIT-III (14 Hours)

UV and Visible Spectroscopy

Measurement technique, Beer – Lambert's Law, molar extinction coefficient, oscillator strength and intensity of the electronic transition, Frank Condon Principle, Ground and first excited electronic states of diatomic molecules, relationship of potential energy curves to electronic spectra. Chromophores, auxochromes, electronic spectra of polyatomic molecules, Woodward rules for conjugated dienes and α, β- unsaturated carbonyl groups, extended conjugated and aromatic sterically hindered systems, red shift, blue shift, hypo- and hyperchromic effect.

UNIT-IV (16 Hours)

Mossbauer Spectroscopy

Mossbauer effect, Principles of Mossbauer spectroscopy, Formation of Mossbauer nuclides, Applications of Mossbauer spectroscopy

Photoelectron Spectroscopy

Introduction, Basic principles of electron spectroscopy, Photoelectric effect, Koopman's theorem, X-ray photoelectron spectroscopy (XPS) or ESCA, Instrumentation for XPS, chemical shifts in XPS, applications of XPS, ultraviolet photoelectron spectroscopy (UPS)

Nuclear Quadrupole Resonance

Introduction- quadrupole nuclei and quadrupole moment, experimental considerations, Electric Field Gradient (EFG), quadrupole coupling constant (QCC), Splitting in NQR spectra, Applications of NQR spectroscopy

Recommended Text Books / Reference Books:

1. Russell S. Drago, 'Physical Method for Chemistry', 2ndEdn., Surfside Scientific Publishers,**1992.**
2. R.M. Silverstein, G.C. Bassler, T.C. Morrill, 'Spectrometric Identification of Organic Compounds', 3rdEdn., Wiley,**1974**.
3. William Kemp, 'Organic Spectroscopy', 3rdEdn., W.H. Freeman,**1991**.
4. Dudley H. Williams & Ian Fleming, 'Spectroscopic Methods in Organic Chemistry', 6thEdn., McGraw Hill, Science,**2008.**
5. J.R. Dyer, 'Application of Absorption Spectroscopy of Organic Compounds', Prentice Hall, Englewood Cliffs, N.J.,**1965**.
6. Dudley H. Williams & Ian Fleming, 'Spectroscopic Problems in Organic Chemistry', 5thEdn., McGraw Hill, London,**1985**.
7. R.C. Banks, E.R. Matjeka, G. Mercer, 'Introductory Problems in Spectroscopy' Manlo Park, CA,**1980**.
8. G.M. Barrow, 'Introduction to Molecular Spectroscopy', McGraw Hill, New York,**1962**.
9. C.N. Banwell 'Fundamentals of Molecular Spectroscopy' 4thEdn., TataMcGrawHill Education,**1994**.
10. D.L. Pavia, G.M. Lampan and G.S. Kriz, 'Introduction to Spectroscopy', 4thEdn., Cengage Learning, **2008**.
11. Jag Mohan, 'Organic Spectroscopy-principles and applications', 2ndEdn., Narosa

Publishing house Pvt. Ltd., **2007**

12. P S Sindhu, 'Fundamentals of Molecular spectroscopy' 2nd Edn., New age international Publishers. **2011**

ORGANOMETALLICS

Subject Code: MCHMS1-202 **L T P C** **Duration: 60Hrs.**
4 0 0 4

Course Objectives

1. To recall classification of ligands and nomenclature of organometallic compounds.
2. To understand structure, bonding and reactivity of organometallic compounds.
3. To familiarize with the role of organometallic compounds in organic syntheses.
4. To understand the applications of organometallic compounds as catalysts.

Course Outcomes:

The students will acquire knowledge of

1. Organometallic compounds and their nomenclature.
2. Bonding and reactivity of metal complexes.
3. Role of organometallic complexes in organic syntheses.
4. Importance of catalyst in syntheses.

UNIT-1 (11 Hrs.)

Introduction- Stability & decomposition pathways, classification of ligands, nomenclature of Organometallic compounds.

18 valence electron rule- Introduction to the 18 valence electron rule, total electron counts and finding metal-metal bonds & related problems.

UNIT-II (17 Hrs.)

Synthesis, structure, bonding & reactivity of organo transition metal complexes.

a) Carbenes, Carbynes, Alkenes, Alkynes, Allylmoieties, Butadiene, Cyclobutadiene, Cyclopentadiene, Arenes, Cycloheptadienylmoieties & Cyclooctatetraenemoieties, Carbonyl.
b) Ferrocenes- Structure & bonding of ferrocenes, basic chemical reactions of ferrocenes, chirality in ferrocene derivatives, ferrocene based condensation polymers.

UNIT-III (16 Hrs.)

Organometallic compounds in organic Synthesis-Green rules, synthesis & use of Zinc dialkyls, Collaman's reagent, organ mercuric& chromium carbonyls in organic synthesis, Heck reaction, Hydrozirconation.

UNIT-IV (16 Hrs.)

Applications of organometallic complexes to Catalysis-Basic principles, Industrial requirements of catalysts, sequences involved in catalytic reaction, asymmetric synthesis using catalyst, Hydrogenation catalysts & their classification, hydrogenation by lanthanide organometallic compounds. Hydro formylation: Cobalt catalyst & phosphine modified cobalt catalysts, Rhodium-phosphine catalysts, factors affecting n/iso ratio of hydro formylation products. Monsato, Cativa & Wacker processes, polymerization & oligomerisation of olefins & dienes, catalyticconverters.

Recommended Books

1. 'Basic Organometallic Chemistry: Concepts, Synthesis & Application ofTransition Metals',

CRC Press & Univ. Press, **2010**.
2. R.C. Mehrotra & A, Singh, 'Organometallic Chemistry, A Unified Approach', New Age International.
3. B.D. Gupta & A.J. Elias, 'Basic Organometallic Chemistry', UniversitiesPress.
4. F.A. Cotton & G. Wilkinson, 'Advanced Inorg, Chemistry', WileyInterSciences.

ORGANIC REACTION AND MECHANISM –II

Subject Code:MCHMS1-203 **L T P C** **Duration: 60 (Hrs.)**
4 0 0 4

Course Objectives:

1. To acquire the knowledge of chemical reactions of Carbon-Carbon and Carbon-Hetero Multiple Bonds .
2. To understand the chemistry behind oxidation, reduction and rearrangement reactions.
3. To acquire the knowledge and use of various reagents and retro synthetic approach used in organic syntheses.
4. To evaluate the organic reactions based on the influence of the substituents on substrate molecule and nature of solvents and other parameters

Course Outcomes:

The students will be able to:

1. Understand chemical reactions of Carbon-Carbon and Carbon-Hetero Multiple Bonds .
2. Apprehend the chemistry behind oxidation, reduction and rearrangement reactions.
3. understand use of diverse reagents in organic synthesis and retrosynthetic approach
4. Evaluate the organic reactions based on the influence of the substituents on substrate molecule and nature of solvents and other parameters

UNIT-I (15 Hrs.)

1. Addition to Carbon-Carbon and Carbon-Hetero Multiple Bonds:

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation. Addition of Grignard reagents, organozinc, organolithium and Gillman reagents to carbonyl and unsaturated carbonyl compounds. Use of other organometallic reagents in addition reactions. Wittig reaction, Mechanism of condensation reactions involving enolates – Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis ofesters.

UNIT-II (15 Hrs.)

2. Oxidation :

Different oxidative processes. Hydrocarbons- alkenes, aromatic rings, saturated C-H groups) activated and inactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines, and sulphides.

Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium (III) nitrate, DDQ, PCC, CAN, selenium dioxide, peroxyacids, DCC. Oxidation reactions with special emphasis on Baeyer-villeger reaction, Cannizarro oxidation-reduction reaction.

UNIT-III (15 Hrs.)

3. Reduction :

Different reductive processes, Hydrocarbons- alkanes, alkenes, alkynes and aromatic rings, Carbonyl compounds – aldehydes, ketones, acids, ester and nitriles. Epoxides, Nitro, nitroso, azo and oxime groups, Hydrogenolysis. Sodium borohydride, sodium cyano borohydride, LAH, disobutylaluminium hydride, tin hydride, trialkyl tin hydride, trialkylsilanes, alkoxy substituted LAH, DIBAL, diborane, diisoamyl borane, hexyl borane, 9-BBN, isopinocamphenyl and disiopinocamphenyl borane. Reduction reactions with particular emphasis on Wolf-Kishner reduction, Clemmensen reduction,

UNIT-IV (15 Hrs.)

4. **Rearrangements :**
General mechanistic consideration – nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofman, Curtius, Schmidt, Shapiro reaction, Fries rearrangement

5. **Retrosynthesis:**
Synthons and synthetic equivalents, Definitions, Guidelines, Functional group interconversions, Use of acetylenes and aliphatic nitrocompounds in organic synthesis; Two-group C-C disconnections – Diels-Alder reaction, 1,3- and 1,5-difunctional compounds (Michael addition and Robinson annulation), Order of events in organic synthesis, Chemoselectivity, Reversal of polarity (umpolung), Cyclisation reactions, Amine synthesis

Recommended Text Books / Reference Books:

1. Jerry March & Michael Smith, ‘March's Advanced Organic Chemistry:Reactions, Mechanisms, and Structure’, 6^{th} Edn., John Wiley &Sons,**2007**.
2. Francis A. Carey & Richard J. Sundberg, ‘Advanced Organic Chemistry: Structureand Mechanisms, Vol, A’, 5^{th} Edn., Springer,**2007**.
3. Francis A. Carey & Richard J. Sundberg, ‘Advanced Organic Chemistry: Reactionand Synthesis’, Vol. B, 4^{th} Edn., Springer,**2006.**
4. K.C. Nicolaou and E.J. Sorensen, ‘Classics in Total Synthesis: Targets, Strategies, Methods’, Wiley,**1996**.

SEMINAR – I

Subject Code: MCHMS1-204 | **L T P C** **0 0 2 1** | **Duration: 30 Hrs.**

Course Objectives

1. To guide the students for the selection of topic of presentation of seminar.
2. To guide the students for preparation of powerpoint presentation.
3. To make the students able to present a seminar and handle the questions of the audience.
4. To improve the soft skills of students.

Course Outcomes

After the completion of this course, the students will be able to

1. Prepare a powerpoint presentation for the seminar to justify the contents of the presentation.
2. Present the seminar before the whole class. This will hone their soft skills.
3. Understand the selected topic thoroughly so as to handle the questions of the audience at the time of presentation.

1. In the beginning of the semester, a teacher will be allocated maximum 30 students. The latter will guide/teach them how to prepare/present 15 minutes Power Point Presentation for the Seminar.

2. If there are more than 30 students in the class, then class will be divided into two group shaving equal students. Each group may be allocated to a different teacher.

3. Each student will be allotted a topic by the teacher at least one week in advance for the presentation. The topic for presentation may be from the syllabus or relevant to the syllabus of the program.

4. During the presentation being given by a student, all the other students of his/her group will attend the seminar. The assessment/evaluation will be done by the teacher. However, Head of Department and other faculty members may also attend the seminar, ask questions and give their suggestions.

5. This is a turn wise continuous process during the semester and a student will give minimum two presentations in a semester.

6. For the evaluation, the following criteria will be adopted,

a) Attendance in seminar: 25 Marks
b) Knowledge of subject along with Questions handling during the seminar: 25 Marks
c) Presentation and communication Skills: 25 Marks
d) Contents of the presentation: 25 Marks.

NANOCHEMISTRY

Subject Code: MCHMD1-211 **L T PC 4 0 0 4** **Duration: 60 Hrs.**

Course Objectives

1. To understand the concept of self-assembly and its applications to various nanostructures.
2. To understand synthesis of nanomaterials.
3. To provide knowledge of characterization of nanomaterials.
4. To give knowledge of applications of nano materials in biological systems.

Course Outcomes:

The students will acquire knowledge of

1. Introduction to the concept of nanochemistry and its classification.
2. Synthesis of nanomaterials by different routes and their characterization.Applications in biological and electronic systems.

UNIT-I(15Hrs)

1. Introduction:

Introdution to nanochemistry and nanotechnology, definition & classification of nanomaterials. Properties & applications of nanomaterials.

2. Self-Assembly and Nanostructures:

Types of self-assemblies, self-assembling materials. Use of self-assembly in nano rod devices, nano wires, nano tubes, molecular logic gates, molecular storage devices, DNA, fullerenes, nano gas sensors.

UNIT-1I(15Hrs.)

3. Nano Material Synthesis:

Top down and bottom up approach, synthesis: Vapour phase synthesis by chemical routes; Nucleation & growth from solutions, stabilization against agglomeration. Processing of nano materials; Nano structured sol gel materials. Consolidation of nano crystalline materials by compaction and sintering, nanolithography.

UNIT-1II(15Hrs.)

4. Characterization Techniques:

Characterization of nano structured materials – by scattering techniques, proximal microscopy (AFM & STM).

UNIT-1V(15Hrs.)

5. Applications:

Bionano composites, biometrics, nano technology enabled sensors, Microelectronics, drug delivery, bionano information.

Recommended Books:

1. C.P. Poole & F.J. Owens, 'Introduction to Nanotechnology', Wiley,**2003**.
2. M. Ratner & D. Ratner, 'Nanotechnology'**,** Prentice Hall,**2003**.
3. M. Wilson, K. Kannagara, G. Smith, M. Simmons & B. Raguse 'Nanotechnology'**,** CRC Press BocaRaton,**2002**.
4. A. Ozin Geoffery & C. Andre, 'Nanochemistry, A Chemical Approach to Nanomaterials'**,**Arsenault Royal Society of Chemists,**2005**.
5. E. Foster Lynn, 'Nanotechnology, Science Innovation & Opportunity', Pearsoneducation,2007.

BIO-ORGANICCHEMISTRY

Subject Code: MCHMD1-212 | **L T PC** | **Duration: 60 Hrs.**

4 0 0 4

Course Objectives

1. To describe the concepts behind amino acids, nucleic acids and protein synthesis
2. To explain the kinetics and mechanism of enzyme catalysis
3. To understand and sketch the mechanisms of asymmetric synthesis
4. To describe the concepts of antisense technology in chemotherapy

Course Outcomes:

After the completion of course students will be able to:

1. Analyze the concepts related to amino acids/nucleic acids/protein synthesis
2. Explain kinetics and mechanism of enzyme catalysis
3. Use concepts of asymmetric synthesis
4. Describe the concepts of antisense technology in chemotherapy

UNIT-1 (15 Hrs.)

Amino Acids and Proteins:

Structure, classification, synthesis and properties of amino acids, isoelectric point, biosynthesis of amino acids. Peptides: oligo- and polypeptides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis. Proteins: classification and properties (denaturation, isoelectric point and electrophoresis), primary, secondary, tertiary and quaternary structures of proteins, collagen and triple helix.

UNIT-1I (15 Hrs.)

Enzymes and Cofactors:

Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: chymotrypsin, ribonuclease and lysozyme, Enzyme-catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerization, group transfer and rearrangement reactions-structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid and Vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.

UNIT-III (15 Hrs.)

Nucleic Acids and Protein Synthesis:

Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA. RNA and protein synthesis: Messenger RNA synthesis-transcription, Ribosomes-rRNA, Transfer RNA, genetic code translation.

Determination of base sequence of DNA. Polymerase Chain Reaction (PCR). Antisense technology in chemotherapy and other nucleic acid-targeted drugs-intercalates, sequence specific drugs. A brief account of ribozyme and iRNA.

UNIT-IV (15 Hrs.)

Lead and Analogue Synthesis-1:

Designing organic synthesis-disconnection approach- synthons and synthetic equivalents-one group disconnections: alcohol, olefin, ketone, acids- two group disconnections:1,2-, 1,3-, 1,4- and 1,5-difunctional compounds-convergent synthesis-functional group interconversions- functional group additions-carbon heteroatom bonds-methods for 3- to 6-membered rings.

Lead and Analogue Synthesis-2:

Combinatorial synthesis in medicinal chemistry: Solid phase techniques-methods of parallel synthesis-mix and split techniques-dynamic combinatorial chemistry-screening and deconvolution-limitations of combinatorial synthesis Asymmetric synthesis: basic principles-stereo selective and stereospecific reactions- methods for determining enantiomeric excess-chiral auxiliary, reagents and catalysts and their applications (wherever applicable) in alkylation, hydrogenation, hydroxylation, epoxidation and hydroboration of alkenes, reduction of ketones-Cram and Felkin-ahn models. Noyori's BINAP – Jacobson catalyst – Evans catalyst.

Recommended Books:

1. Hermann Dugas and C. Penny, 'Bioorganic Chemistry: A Chemical Approach to Enzyme action',Springer-Verlag.
2. N.C. Price and L. Stevens, 'Fundamentals of Enzymology', Oxford UniversityPress.
3. C. Walsh, W.H. Freeman, 'Enzymatic ReactionMechanisms'.
4. Stuart Warren, 'Designing Organic Synthesis: The Disconnection Approach', 2^{nd}Edn., Wiley,**1984**.
5. H.B. Kagan, 'Asymmetric Synthesi', Thieme Medical Publishers,**2003**.
6. Francis A. Carey and Richard B. Sundberg, 'Advanced Organic Chemistry: Part-A and Part-B', 5^{th} Edn., Springer,**2007**.

ANALYTICAL CHEMISTRY

Subject Code: MCHMD1-213 | **L T P C** 4 0 0 4 | **Duration: 60 (Hrs.)**

Course Objectives:

1. To introduce the theory and importance of analytical chemistry.
2. To familiarize with the importance of various methods of quantitative estimations.
3. To introduce various analytical techniques and their significance.
4. To introduce analytical treatment of data for reporting results.

Course Outcomes:

The students will be able to:

1. Understand basic concepts and importance of analytical chemistry.
2. Analyse and compile the results of calculations in a scientific manner.
3. Understand various analytical techniques and their significance.
4. Apply the knowledge of analytical chemistry to solve the related problems.

UNIT-I (18 Hrs.)

Introduction to Analytical Chemistry

Classification of Analytical Methods. Types of samples, Preparation of sample for analysis, effect of sampling uncertainties, sample treatment, procedure of sampling of solids, liquids and gases.

Errors and Evaluation

Accuracy, precision, sensitivity, detection limits, significant figures, rounding off noise and sources, Uncertainties, errors. Types of errors – determinate and indeterminate errors. Ways of expressing accuracy, absolute and relative errors. Significant figures and propagation of errors. Confidence limit, Test of significance – the F-test and T-test. The statistical Q-test for rejection of a result, calibrations, mean, standard deviations. Linear least squares method. The correlation coefficient. Calculation for the above parameters.

Thermo analytical Techniques

Principle of thermogravimetry, thermogravimetric analysis, differential thermal analysis, differential scanning calorimetry, instrumentation for TGA, DTA and DSC, Methodology of TG, DTA and DSC. Application of TG to study of oxalates and chromates, factors affecting TGA and DTA curves. Applications of thermal analysis.

UNIT-II (15 Hrs.)

Electrochemical Techniques

a) D.C Polarography: Instrumentation - Dropping mercury electrode- -polarogram. Types of Currents: Residual, Migration, Limiting. Two and Three electrode assemblies. Ilkovic equation (derivation not required). Applications of polarography in qualitative and quantitative analysis. Analysis of mixtures. Application to inorganic and organic compounds. Determination of stability constants of complexes.

b) Brief account of following techniques:

(i) Pulse technique (ii) Differential pulse technique (iii) Cyclic Voltammetry (iv) Square-wave technique

c) Amperometric titrations: Principle, Instrumentation. Types and applications amperometric titrations.

Chromatography

Classification of chromatographic techniques, differential migration rates, partition ratio, retention time, relation between partition ratio and retention time, capacity factor, selectivity factor. Efficiency of separation- resolution, diffusion, plate theory and rate theory HPLC: Principle, instrumentation, supports in HPLC. Applications of HPLC systems. Supercritical fluid chromatography (SFC). Recent developments in SFC and applications.

UNIT-III (12 Hrs.)

Microscopy Techniques

Basic principle, instrumentation and applications of electron microscopy - SEM, TEM, scanning probe microscopy – STM, AFM.

Cryo-electron microscopy

Principle, instrumentation and applications, advantages and challenges, cryo-SEM, cryo-TEM, vitrification, cryo-electron microscopy of vitreous sections, ice contamination, cryo-negative staining, brief account of cryo-fixation methods, 2-D crystallization of membrane protein and cryo-preparation of 2-D crystal samples, brief discussion on cryo- electron tomography.

UNIT-IV (15 Hrs.)

Nuclear Chemistry:

Nuclear binding energy and stability, nuclear models (nuclear shell model and collective model). Nuclear reactions: types of reactions, nuclear cross-sections, Q-value. Natural and artificial radioactivity, radioactive decay and equilibrium, Nuclear fission-fission product and fission yields, Nuclear fusion.

Radiochemical methods of analysis:

Radioactive tracer techniques and its applications, isotope dilution analysis, neutron activation analysis, Counting techniques such as G.M. Ionization and proportional counters.

Separation methods:

Solvent extraction: Partition law and its limitations, distributionratio, separation factor, factor influencing extraction, multiple extractions.

Recommended Text Books / Reference Books:

1. A Douglas, Skoog and Donald M. West, F.J. Holler, 'Fundamentals of Analytical Chemistry', 8thEdn., Harcourt College Publishers, **2004**.
2. Skoog, Holder, Nieman, 'Principles of Instrumental Analysis', 5thEdn., Thomson Books, **1998**.
3. J. Mendham, R.C. Denney, J.D. Barnes, M. Thomas, 'Vogel's Text Book of Quantitative Chemical Analysis', 6thEdn., Pearson Education, **2006**.
4. R. Gopalan, P.S. Subramaniam and K. Rengarajan, 'Elements of Analytical Chemistry', 3rdEdn.,Sultan Chand and Sons,**2003**.
5. S. Usharani, 'Analytical Chemistry', Macmillan Publishers,**2000**.
6. A. Cavalier, D. Spehner, B.M. Humbel, 'Handbook of Cryo-Preparation Methods for Electron Microscopy', CRC Press, Taylor & Francis Group, **2009**.
7. B. C. Harvey, 'Introduction to Nuclear Chemistry',Prentice-Hall, **1969**.
8. G. Friedlander, J. W. Kennedy, E.S. Marcus, J.M. Miller, 'Nuclear & Radiochemistry', John Wiley & Sons, **1981**.
9. H.J. Arnikar, 'Nuclear Chemistry', Wiley Eastern Co., II Edition, **1987**.
10. A. Braithwaite and F.J. Smith, 'Chromatographic Methods',5th Ed., Blackie

Academic and Professional, London, **1996**.

NATURAL PRODUCTS

Subject Code: MCHMD1-221 | **L T PC 4 0 0 4** | **Duration: 60Hrs.**

Course Objectives

1. To acquire basic knowledge of isolation, purification, identification and standardization of natural products.
2. To discuss structure elucidation of alkaloids, terpenoids , steroids, vitamins and carotenoids.
3. To understand the qualitative and quantitative analysis of natural compounds.
4. To discuss the use and importance of natural products.

Course Outcomes:

The students will be able to:

1. Understand the procedures involved in Isolation, purification, identification and standardization of natural products.
2. Elucidate the structure of alkaloids, terpenoids , steroids, vitamins and carotenoids.
3. Analyze the natural products quantitatively and qualitatively
4. Appreciate the use and importance of natural products in day to day life.

UNIT-I (15 Hrs.)

1. Introduction & General Methods

Isolation, purification, identification and standardization of natural products. Carbohydrates and metabolism: Introduction, stereoisomerism, mutarotation, configuration and ring structure of monosaccharides, disaccharides and polysaccharides. Glycolysis, alcoholic and lactic acid fermentation, citric acid cycle.

UNIT-II (15 Hrs.)

Introduction, classification, isolation and purification of alkaloids and terpenoids. Structure elucidation of alkaloids (atropine, quinine, morphine) and terpenoids (camphor and menthol). Biosynthesis of alkaloids and terpenoids.

UNIT-III (15Hrs.)

2. Steroids

General introduction, isolation, purification and structure elucidation stereochemistry of sterols with special reference to cholesterol. Vitamin D group and bile acids. Biosynthesis of sterols.

UNIT-IV (15Hrs.)

3. Carotenoids andVitamins

Introduction to carotenoids and vitamins, Carotenes. Vitamin A, xanthophyll, vitamin B complex, vitamin K and vitamin E group.

Recommended Books

1. I.L. Finar, 'Organic Chemistry: Stereochemistry and The Chemistry Natural Products', Vol. II, 5th Edn., Longman Scientific & Technical, **1988**.
2. O.P. Agarwal, 'Chemistry of Organic Natural Products', Vol. I, 40thEdn., Krishna Prakashan

Media,**2010.**

3. O.P. Aggarwal, 'Organic Chemistry Natural Products', Vol. II, 38th Edn.,Krishna Prakashan Media,**2010.**

BIO-PHYSICALCHEMISTRY

Subject Code: MCHMD1-222 **L T PC** **Duration: 60Hrs.**

4 0 0 4

Course Objectives:

1. To equip with basic knowledge of the physical principles that govern chemical systems.
2. To provide knowledge of various biological systems with emphasis on biochemical reactions.
3. To recall enzyme concepts, and their role in chemical and biological catalysis.
4. To understand various principles that govern cellular processes.

Course Outcomes:

The students will be able to

1. Understand the importance of enzymes in biological processes.
2. Appraise various interactions between biomolecules.
3. Conceptualise the thermodynamics in biological systems.
4. Connect chemistry with biological processes.

UNIT I (15Hrs)

Biological Cell and its Constituents:

Biological cell, DNA and RNA in living systems. Basic consideration. Proximity effects and molecular adaptation.

Enzymes:

Introduction and historical perspective, chemical and biological catalysis, Remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics, Michaelis-Menten and Line Weaver-Burk plots, reversible and irreversible inhibition.

UNIT II (15Hrs)

Kinds of Reactions Catalyzed by Enzymes:

Nucleophilic displacement on a phosphorus atom, multiple displacement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reaction, enolic intermediates in isomerization reactions, b-cleavage and condensation, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation.

Co-Enzyme Chemistry:
Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological function of coenzyme A, thiamine pyrophosphate, Pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid, vitamin B12. Mechanism of reaction catalyzed by the above cofactors.

UNIT III (15Hrs)

Biological Macromolecules:

The Nucleic Acids:
Nucleotide, torsion angles in poly nucleotide chains, the helical structure of polynucleic acids, high order structure in polynucleotides.

Interactions in Macromolecules:
Basic principles of interaction between molecules, water structure and its interaction with biomolecules, dipole interactions, side chain interactions, electrostatic interactions, base pairing in nucleic acids, base stacking, hydration and the hydrophobic effect.

Structural Transition in Bio-macromolecules:
Coil – helix transitions in proteins, statistical methods for predicting protein secondary structures; melting and annealing of polynucleotide duplexes, helical transitions in double stranded DNA, super coil dependent DNA transitions predicting helical structures in genomic DNA.

UNIT IV (15 Hrs)

Bioenergetics and ATP cycle

Standard free energy change in biochemical reaction, exergonic, endergonic reactions. Hydrolysis of ATP, synthesis of ATP from ADP, metal complexes and transition of energy, chlorophylls, photo system I and photo system II in cleavage of water.

Thermodynamics of Biopolymer Solutions
Thermodynamics of biopolymers solutions, osmotic pressure, membrane equilibrium, muscular contraction and Energy generations in mechano-chemical system.

Recommended Books:

1. A.L. Lehninger, ‘Principles of Biochemistry’, WorthPublishers.
2. Voet; ‘VoetBiochemistry’, John Wiley,**1995**.
3. E.E. Conn, P.K. Stumpt, ‘Outlines of Biochemistry’, JohnWiley.
4. Hermann Dugas, C. Penny, ‘Bioorganic Chemistry: Chemical Approach toEnzyme Action’, Springer Verlag,**1982**.
5. M.I. Page, A. Williams, ‘Enzyme Mechanisms, ’Royal Society ofChemistry’.
6. Richard B. Silverman, ‘Organic Chemistry of Enzyme CatalysedReaction’.
7. I. Bertini, H.B. Gray, S.J. Lippard, J.S. Valentine, ‘Bioinorganic Chemistry’, UniversityScience Books.
8. William Jolley, ‘BioinorganicChemistry’.
9. K.E. VanHolde, W.C. Johnson, P.S. Ho, ‘Principles of Physical Biochemistry’,Prentice Hall,**1998**.
10. L.Stryer, ‘Biochemistry’, W.H.Freeman.
11. J. DavidRawn, ‘Biochemistry’, NeilPatterson.
12. F. Wold, ‘Macromolecules: Structure and Function’, PrenticeHall.

13. C.R. Cantor, P.R. Schimmel, 'Biophysical Chemistry', Vol. 1-3, Freeman, **1980**.

ASYMMETRIC SYNTHESIS

Subject Code: MCHMD1-223

L	T	P	C
4	0	0	4

Duration: 60 (Hrs.)

Course Objectives:

1. To learn basic principles behind chirality/asymmetric synthesis
2. To understand analytical methods/techniques used in asymmetric synthesis
3. To illustrate substrate controlled/chiral auxiliary controlled asymmetric reactions mechanistically
4. To describe chiral reagent controlled asymmetric reactions mechanistically

Course Outcomes:

After the completion of course students will be able to:

1. Outline basic principles behind chirality/asymmetric synthesis
2. Explain analytical methods/techniques used in asymmetric synthesis
3. Write mechanisms of substrate controlled/chiral auxiliary controlled asymmetric reactions
4. Sketch the mechanisms of chiral reagent controlled asymmetric reactions

UNIT-I (18 Hrs.)

Basic Principles of Chirality and Asymmetric Synthesis:

Phenomenon of chirality, Need for asymmetric synthesis, Selective synthesis of enantiomers, Enantiomeric purity of natural products, stereogenic unit and types of chiral compound , Centrally chiral compounds of carbon, Centrally chiral compounds of nitrogen and phosphorus, Centrally chiral compounds of sulphur, Axially chiral compounds, Chiral molecules with more than one stereo genic unit: diastereomers, The selective synthesis of diastereomers, Prochirality: enantotopic and diastereotopic groups. Definition: enantiotropic and diastereotropic groups and faces – Symmetry, substitution and addition criteria. Prochirality nomenclature: Pro – R, Pro – S, Re and Si. Selectivity in synthesis: Stereospecific reactions (substrate stereoselectivity), Stereoselective reaction (Product stereoselectivity), Enantioselectivity and diastereoselectivity. Chemoselectivity, Regioselectivity. Conditions of Stereoselectivity: Symmetry and transition state criteria, kinetic and thermodynamic control. Methods for inducing enantio- and diastereoselectivity.

UNIT-II (12 Hrs.)

Analytical Methods:

Determining % Enantiomeric excess, % Enantioselctivity, Optical Purity, % Diastereomeric excess and % diatereoselectivity. Resolving agents and resolution of recemic compounds having common functional groups e.g. alcohol, amine, acid. Techniques for determination of Enantioselectivity, Polarimetric methods, Gas chromatography methods, Liquid chromatographic methods. NMR spectroscopy-Chiral derivatising agents (CDAs), Chiral solvating agents (CSAs), Chiral lanthanide shift reagents (CLSRs).

UNIT-III (18 Hrs.)

Classification of Asymmetric Reactions:

i) Substrate controlled asymmetric synthesis: Nucleophilic addition to chiral carbonyl compounds, 1,2 –Asymmetric induction, Felkin-Anh model, Double stereo differentiation; matched pair and mismatched pair, Examples from aldol condensation and hydroborationreactions

ii) Chiral auxiliary controlled asymmetric synthesis: α-alkylation of chiral enolates, azaenolates, imines and hydrazones, chiral sulphoxides. 1,4-asymmetric induction and Prelog's rule, use of chiral auxiliary in Diels-Alder and Cope reactions

iii) Chiral reagent controlled asymmetric synthesis: Asymmetric reduction using BINAL-H. Asymmetric Michael addition to α, β-unsaturated carbonyl compounds, Chiral lithium amides- enantioselective deprotonation, applications of chiralorganoboranes.

UNIT-IV (12 Hrs.)

Classification of Asymmetric Reactions (Continued Unit III):

iv) Chiral catalyst controlled asymmetric synthesis: Sharpless, Jacobson and Shi asymmetric epoxidation, Sharpless asymmetric dihydroxylation and amino hydroxylation. Asymmetric hydrogenations using chiral Wilkinson biphosphine and Noyori catalyst. Chiral catalyst controlled Diels-Alder and Michael reactions, Jacobson Catalysts-Evans Catalyst- Aziridination, Enzyme mediated enantioselective synthesis.

Recommended Text Books / Reference Books:

1. R. A. Aitken, S. N. Kilenyi, Asymmetric Synthesis, Originally published by Chapman &Hall, **1992**.
2. Guo-Qiang Lin, Yue-Ming Li, Albert S. C. Chan, Princilpes and applications of Asymmetric Synthesis, Wiley Interscience, **2001**
3. J.D. Morrison and H.S. Moscher, 'Asymmetric Organic Reactions', Vol 1-5, Academic Press,**1983.**
4. E.N. Jacobsen, A. Pfaltz, H. Yamamoto, 'Comprehensive Asymmetric Catalysis', Eds. Springer,**2000.**
5. R.S. Ward, 'Stereoselectivity in Organic Molecules', Wiley, New York,**1999**.
6. E.L. Eliel, 'Stereochemistry of Carbon Compounds', Wiley,**1992**.
7. W. Carruthers, 'Some Modern Methods of Organic Synthesis', Cambridge University Press, 4th Edn.,**2012.**
8. I. Ojima, 'Catalytic Asymmetric Synthesis', VCH-NY,Pergamon.**1998.**
9. R.E. Gawley, J. Aube, 'Principles of Asymmetric Synthesis' (Tetrahedron Series in Organic Chemistry),Pergamon,**1996.**
10. H.B. Kagan, 'Asymmetric Synthesis', Edn., I, Thieme Medical Publishers,**2003**.
11. G. Proctor, 'Asymmetric Synthesis', Oxford University Press, USA,**1997**.

INORGANIC CHEMISTRY LAB-II

Subject Code: MCHMS1-205 **L T P C** **0 0 4 2** **Duration – 60 Hrs.**

Course Objectives

1. To extend knowledge of use of standard laboratory equipment, modern instrumentation and classical techniques to carry out experiments.
2. To synthesize various inorganic complexes and their qualitative determination by UV,IR, NMR and ESR techniques.

Course Outcomes:

The students will acquire knowledge of

1. Volumetric and gravimetric analysis of cations and anions.
2. Understand electro analytical techniques.
3. Syntheses of various complexes and their structural analysis.
4. Use of various spectroscopic techniques like UV, IR, NMR for structural determination.

Note:
1. Students will have to perform atleast 10-12 experiments from the given syllabus.

2. Any other subject related experiment can also be included.

1. **Gravimetric Analysis of Cations and Anions:** Iodide, thiocyanate, Sulphate, oxalate chloride, nickel, copper cobalt, zinc and their mixture.
2. **Determination of Metal Ions Using Solvent Extraction**:
   a) Determination of copper as the diethydithiocarbamatecomplex
   b) Determination of iron as the 8hydroxyquinolate
   c) Determination of nickel as the dimethylglyoxime complex,
3. **Electro Analytical Techniques**
   pHmetric, Conductometric Titration: Representative acid/base and redox titrations.
4. **Colorimetry and Spectrophotometry**
   a) Determination of λ_{max} the absorption curve and concentration of asubstance
   b) Determination of copper (II) with EDTA
   c) Determination of iron (III) with EDTA.

Recommended Books:

1. H. Denny, W. Roesky, ‘Chemical Curiosites’, WILEY VCH,**1996**.
2. G. Marr and B.W. Rocket, ‘Practical Inorganic Chemistry’, University ScienceBooks, **1999.**
3. G. Pass and H. Sutcliffe, ‘Practical Inorganic Chemistry’, Chapman and Hall,London, **1968**.
4. J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, ‘Vogel’s Textbook of Quantitative Analysis’, Pearson Education,**2006.**
5. G. Svehla, ‘Vogel’s Textbook of Quantitative Analysis’, PearsonEducation,**2006**.
6. Anil J. Elias, ‘A Collection of Interesting General Chemistry Experiments’, University Press,**2002.**

Note: The students are required to perform atleast 2 experiments from each section.

Total Credits= 24

3rd Semester		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCHMS1-301	Molecular Spectroscopy-II	4	0	0	40	60	100	4
MCHMS1-302	Quantum Chemistry	4	0	0	40	60	100	4
MCHMS1-303	Heterocyclic Chemistry	4	0	0	40	60	100	4
MCHMS1-304	Seminar – II	0	0	2	100	-	100	1
Departmental Elective-IV (Choose any one)		4	0	0	40	60	100	4
MCHMD1-311	Surface Chemistry & Catalysis							
MCHMD1-312	Medicinal Chemistry							
MCHMD1-313	Green Chemistry							
Open Elective-II		3	0	0	40	60	100	3
MCHMS1-305	Organic Chemistry Lab.-II	0	0	4	60	40	100	2
MCHMS1-306	Physical Chemistry Lab.-I	0	0	4	60	40	100	2
Total		**-**	**-**	**-**	**420**	**380**	**800**	**24**

Total Credits= 20

4th Semester		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MCHMS1-401	Photochemistry and Pericyclic Reactions	4	0	0	40	60	100	4
MCHMS1-402	Bio-inorganic Chemistry	4	0	0	40	60	100	4
MREM0-101	Research Methodology	4	0	0	40	60	100	4
MCHMS1-403	Physical Chemistry Lab.-II	0	0	4	60	40	100	2
Optional* (Choose any one)		0	0	8	60	40	100	4
MCHMS1-404	Dissertation							
MCHMS1-405	Term Paper							
MCHMS1-406	Advanced Lab	0	0	4	60	40	100	2
Total		**-**	**-**	**-**	**300**	**300**	**600**	**20**

Overall Marks / Credits

Semester	Marks	Credits
1st	700	23
2nd	700	23
3rd	800	24
4th	600	20
Total	**2800**	**90**

Departmental Elective: Subject to the availability of teacher and minimum 10 students as per university guidelines.

Open Elective: Student must choose open elective subject offered by other department.

Optional*:

Dissertation- Maximum 20% of the sanctioned strength of the students will be allotted dissertation on the basis of their option and percentage of marks (Merit) in M.Sc. Istyear examination subject to the consent of the faculty in the Department. Maximum students guided by each faculty cannot be more than two.

Term paper: The students who have not been allotted dissertation, will be offered term paper.

MOLECULAR SPECTROSCOPY-II

Subject Code: MCHMS1-301	L T P C 4 0 0 4	Duration: 60(Hrs.)

Course Objectives:

1.To provide the fundamental knowledge of principles of NMR, Mass and ESR spectroscop
2. To understand the application of spectroscopic concepts.
3. To understand the explanation behind the observed features the spectra of compounds.
4. To give the knowledge of structure elucidation based on spectroscopic data.

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Course Outcomes:

The students will be able to

1. Understand the basic and advanced concepts of NMR, ESR and mass spectroscopy.
2. Apply the concepts of spectroscopy to understand the explanation behind the observed features of spectra
3. Analyze and understand the spectra of compounds.
4. Elucidate the structure of molecules on the basis of given spectroscopic data.

UNIT-I (15 Hours)

Nuclear Magnetic Resonance Spectroscopy

The nuclear spin, precessional motion. Larmor frequency, the NMR isotopes, population of nuclear spin levels, spin – spin and spin – lattice relaxation, measurement techniques, Solvents used, Chemical Shift, shielding constant, range of typical chemical shifts simple applications of chemical shift ring currents and aromaticity, shifts of ^{1}H and ^{13}C, inductive effect, ring current effect and anisotropy chemical bonds, intermolecular forces effecting the chemical shifts. Spin – spin interactions, low- and high-resolution NMR with various examples. Heteronuclear coupling of ^{1}H to other nuclei such as nitrogen, phosphoros and fluorine oxygen and sulphur. spin – spin interaction. Interaction between two or more nuclei, splitting due to vicinal and germinal protons, Coupling constant- mechanism of coupling, one, two and three bond coupling, long range coupling. Karplus relationship

UNIT-II (15 Hours)

Nuclear Magnetic Resonance Spectroscopy (contd.)

First order and second spectra, spin system notation, A_2, AB, AX, AB_2,AX_2, ABC, ABX, $A_2B_2$and A_2X_2systems, magnetic equivalence, shifts reagents. Effects of chemical exchange, fluxional molecules, Hindered rotation on NMR spectrum,. Nuclear magnetic double resonance, spin decoupling, Nuclear Overhauser Effect (NOE), Advanced NMR techniques- COSY, HETCOR, NOESY

^{13}C-Nuclear Magnetic Resonance Spectroscopy

^{13}C- ^{1}H coupling, ^{13}C chemical shift, ^{13}C spectra- proton coupled and decoupled, Differences of ^{13}C from ^{1}H NMR, DEPT, Nuclear OverhauserEffect, Cross Polarization, Intensities of lines in ^{13}C, Problems with integration in ^{13}C spectra.

UNIT-III (15 Hours)

Mass Spectroscopy

Introduction, methods of ionization EI & CI, Laser desorption, Fast Atom Bombardment (FAB). Secondary Ion Mass Spectrometry (SIMS), field desorption etc. Ion analysis methods (in brief), isotope abundance, Metastable ions, Electron Impact mass spectra, fragmentation patterns for aliphatic compounds, amines, aldehydes, ketones, esters, amides, nitriles, carboxylic acids ethers, aromatic compounds, general rules predicting the fragmentation patterns.

UNIT-IV (15 Hours)

Electron Spin Resonance Spectroscopy

Introduction, Factors affecting g values, limitations of ESR, Comparison of ESR and NMR, Instrumentation, hyperfine structure- isotropic and anisotropic interactions, ESR spectra of Deuterium, Triplet states-zero field splitting and Kramer's degeneracy, McConnel relationship, Study of inorganic compounds by ESR

Structure Elucidation

Structure elucidation by combined application of UV, IR, NMR and mass spectra. Solving first 20 problems from reference book 6 and first 20 problems from reference book 8.

Recommended Text Books / Reference Books:

1. C.N. Banwell 'Fundamentals of Molecular Spectroscopy' 4thEdn., TataMcGraw-Hill Education,**1994**.
2. William Kemp, 'Organic Spectroscopy', 3rdEdn., W.H. Freeman,**1991**.
3. Dudley H. Williams & Ian Fleming, 'Spectroscopic Methods in Organic Chemistry', 6thEdn., McGraw Hill, Science,**2008.**
4. Russell S. Drago, 'Physical Method for Chemistry', 2ndEdn., SurfsideScientific Publishers,**1992.**
5. R.M. Silverstein, G.C. Bassler, T.C. Morrill, 'Spectrometric Identification of Organic Compounds', 3rdEdn., Wiley,**1974**.
6. D.L. Pavia, G.M. Lampan and G.S. Kriz, 'Introduction to Spectroscopy' 4thEdn., Cengage Learning, **2008**.
7. R.C. Banks, E.R. Matjeka, G. Mercer, 'Introductory Problems in Spectroscopy' Manlo Park, CA,**1980**
8. Jag Mohan, 'Organic Spectroscopy-principles and applications', 2nd Edn., Narosa Publishing house Pvt. Ltd., 2007

QUANTUM CHEMISTRY

Subject Code: MCHMS1-302	L T P C 4 0 0 4	Duration: 60(Hrs.)

Course Objectives:

1. Master fundamental quantum mechanical principles and problem-solving techniques.
2. To gain detailed understanding of quantum chemical description of chemical bonding, reactivity and angular momentum
3. Learn how quantum mechanics manifests itself in nature and experimental science.
4. Understand advantages and limitations of approximation methods for solving complex problem

Course Outcomes:

The students will be able to:

1. Understand quantum mechanical principles and problem-solving techniques.
2. understand working knowledge of terminology and tools used by quantum chemistry
3. Apply approximate methods in quantum chemistry
4. Develop working knowledge of terminology and tools used by quantum chemistry.

UNIT-I (15Hrs.)

Quantum Mechanics: limitations of classical mechanics, Operators , Hermitian operators and their properties. Commutation relations. Wavefunctions and Eigenvalue Equations, Expectation Values. Postulates of quantum mechanics. Uncertainty Principle, Schrodinger wave equation. Discussion of solutions of the Schrodinger equation to some model systems viz., Particle in a box, The Harmonic Oscillator and tunneling.

UNIT-II (15 Hrs.)

Discussion of solutions of the Schrodinger equation to some model systems : The Rigid Rotor, The Hydrogen atom.

Approximate Methods: The Variation Theorem, Linear Variation Principle, Perturbation Theory (first order and non-degenerate). Applications of Variation Method and Perturbation Theory to the Helium atom.

UNIT-III (15 Hrs.)

Angular Momentum: Ordinary angular momentum, Generalized angular momentum, Eigen functions for angular momentum, Eigen values of angular momentum, Operator using ladder operators, Addition of angular momentum, Spin, Antisymmetry and Pauli exclusion principle. Electronic Structure of Atoms: Electronic configuration, Russell-Saunders terms and Coupling Schemes, Slater-Condon parameters, Term Separation Energies of the p^n Configuration, Term Separation Energies for the d^n Configurations, Magnetic Effects: Spin-orbit Coupling and Zeeman Splitting, Introduction to the methods of Self-consistent field, The Virial Theorem.

UNIT-IV (15 Hrs.)

Born-Oppenheimer Approximation: Hydrogen molecule ion. LCAO-MO and VB treatments of the Hydrogen molecule; Electron Density, Forces and their role in Chemical Binding. Hybridization and valence MOs of H_2O, NH_3 and CH_4. Huckel Theory of Conjugated Systems, Bond Order and Charge Density Calculations, Applications to Ethylene, Butadiene, and Cyclobutadiene.

Recommended Text Books / Reference Books:

1. P.W. Atkins and R.S. Friedman, 'Molecular Quantum Mechanics', 4thEdn., Oxford University Press,**2004**.
2. D. McQuarrie, 'Quantum Chemistry', '2ndEdn., University Science Books',**2008**.
3. I.N. Levine, 'Quantum Chemistry', 5thEdn., Prentice Hall,**2006**.
4. F.L. Pilar, 'Elementary Quantum Chemistry', McGraw Hill,**1968**.
5. N.H. March, 'Self-Consistent Fields in Atoms', Pergamon Press,**1975**.
6. A.K. Chandra, 'Introductory Quantum Chemistry', Tata McGraw Hill,**1988**.
7. J.A. Popleand D.L. Beveridge, 'Approximate Molecular-Orbital Theory', McGraw Hill, NY,**1970**.
8. J.P. Lowe, 'Quantum Chemistry', AcademicPress,**1993**.

HETEROCYCLIC CHEMISTRY

Subject Code: MCHMS1-303 **L T PC 4 0 0 4** **Duration: 60Hrs.**

Course Objectives

1. To provide the fundamental knowledge of heterocyclic compounds.
2. To understand the concept of nomenclature of heterocyclic compounds.
3. To give the knowledge of applications of Heterocyclic compounds in pharmaceutical industries.

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Course Outcomes:

After completion of the course the student will

1. acquire the skill of naming heterocyclic compounds
2. Providing theoretical understanding of heterocyclic chemistry which includes various methods for ring synthesis, properties and reactions.
3. Apply the knowledge of synthesise heterocyclic compounds in wide medicinal field.

UNIT-I (15 Hrs).

Nomenclature of Heterocycles

Replacement and systematic nomenclature (Hantzsch Widman system) for monocyclic, fused and bridged heterocycles.

Aromatic Heterocycles

General chemical behaviour of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond length, ring current and chemical shifts in 1H NMR-spectra, empirical resonance energy, delocalization energy and Dewar resonance energy, diamagnetic susceptibility exaltation). Heteroaromatic reactivity and tautomerism in aromatic heterocycles.

UNIT–II(15 Hrs).

Non Aromatic Heterocycles

Strain bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3 diaxial interaction. Stereo-electronic effects – anomeric and related effects. Attractive interactions – hydrogen bonding and intermolecular nucleophilic – electrophilic interactions.

UNIT–III(15 Hrs).

Heterocyclic Synthesis

Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reactions.

Small Ring Heterocycles

Three membered and four membered heterocycles- synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.

UNIT –IV (15 Hrs.)

Benzo-Fused Five-Membered Heterocycles

Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans, and benzothiophenes.

Meso-Ionic Heterocycles

General classification, chemistry, chemistry of some important meso-ionic heterocycles of type-A and B and their applications.

Recommended Books

1. R.R. Gupta, M. Kumar and V. Gupta, 'Heterocyclic Chemistry: Principles, Three- and Four-Membered Heterocycles, Vol. 1', Springer Berlin Heidelberg,**1998.**
2. R.R. Gupta, M. Kumar and V. Gupta, 'Heterocyclic Chemistry: Five-Membered Heterocycles, Vol. 2', Springer Berlin Heidelberg,**1999.**
3. T. Eicher and S. Hauptmann, 'The Chemistry of Heterocycles', Georg Thieme,Stuttgart, **1995.**
4. J.A. Joule, K. Mills and G.F. Smith, 'Heterocyclic Chemistry', 5th Edn., John Wiley& Sons,**2010.**
5. T.L. Gilchrist, 'Heterocyclic Chemistry', 3rd Edn., Pearson Education India,**2007.**
6. G.R. Newkome and W.W. Paudler, 'Contemporary Heterocyclic Chemistry', Wiley-Inter Science, New York,**1982.**
7. R.M. Acheson, 'An Introduction to the Heterocyclic Compounds', John Wiley & Sons Ltd., New York, London,**1976.**
8. A.R. Katritzky and C.W. Rees, 'Comprehensive Heterocyclic Chemistry',Pergamon Press, Oxford,**1984.**

SEMINAR – II

Subject Code: MCHMS1-304 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objectives

1. To mentor the students for the selection of the topic of seminar.
2. To counsel the students for preparation of powerpoint presentation.
3. To make the students able to present a seminar and handle the questions of the audience.
4. To improve the soft skills of students.

Course Outcomes

After the completion of this course, the students will be able to

1. Prepare a powerpoint presentation for the seminar to justify the contents of the presentation.
2. Present the seminar before the whole class. This will hone their soft skills.
3. Understand the selected topic thoroughly so as to handle the questions of the audience at the time of presentation.

1. In the beginning of the semester, a teacher will be allocated maximum 30 students. The teacher will guide/teach them how to prepare/present 15 minutes Power Point Presentation for the Seminar.

2. If there are more than 30 students in the class, then class will be divided into two group shaving equal students. Each group may be allocated to a different teacher.

3. Each student will be allotted a topic by the teacher at least one week in advance for the presentation. The topic for presentation may be from the syllabus or relevant to the syllabus of the program.

4. During the presentation being given by a student, all the other students of his/her groupwill attend the Seminar. The assessment/evaluation will be done by the teacher. However, Head of Department and other faculty members may also attend the Seminar, ask questions and give their suggestions.

5. This is a turn wise continuous process during the semester and a student will give minimum two presentations in a Semester.

6. For the evaluation, the following criteria will be adopted,
(a) Attendance in Seminar: 25 Marks
(b) Knowledge of Subject along with Questions handling during the Seminar: 25 Marks
(c) Presentation and Communication Skills: 25 Marks
(d) Contents of the Presentation: 25 Marks.

SURFACE CHEMISTRY & CATALYSIS

Subject Code: MCHMD1-311 | **L T P C 4 0 0 4** | **Duration: 60 Hrs.**

Course objective:

1. To provide the fundamental knowledge of surface Chemistry and catalyst.
2. To familiarize with surface phenomena.
3. To understand the concept of Organized Molecular Assemblies and their analytical applications.
4. To give the knowledge of industrial applications of catalyst.

Course Outcomes:

After completion of the course the students will acquire knowledge of

1. Fundamental principles of surface chemistry, and their applications in industries.
2. providing theoretical understanding of surface Chemistry .
3. Analyze the experimental techniques for different catalytic reactions.
4. Development of various catalyst and their applications in industry.

UNIT-I (15 Hrs.)

Structural Aspects of Organized Molecular Assemblies

Surfactants, classification of surfactants, micelles, critical micellar concentration,different methods for determination of critical micellar concentration, thermodynamicsof micellization, aggregation number, shape & size and their determination, shapetransition, reverse micelles, emulsion, microemulsion (oil in water and water in oil),effect of cosurfactants, thermodynamics of microemulsion formation.

UNIT-II (15 Hrs.)

Analytical Applications of Organized Assemblies

Application of micellar systems for UV-Visible/fluorescence spectroscopic detection ofions, micellar enhanced phosphorescence and fluorescence, micellar systems in liquid liquid extraction, surfactant aggregates in flame and plasma atomic spectrometry,micellar systems in chromatography, recent developments in micellar chromatography,application of surfactants in gel electrophoresis.

UNIT-III (15 Hrs.)

Catalysts

Classification of catalysis to homogeneous and heterogeneous, Basic concepts in heterogeneous catalysis, catalyst preparation and catalyst characterization, Surface reactivity and kinetics of reaction on surfaces, poisoning and regeneration, enzymatic, phase transfer catalysis, influence of heat and mass transport on the rate of catalytic process. Evaluation of activity and selectivity of catalysts.

UNIT-IV (15 Hrs.)

Industrial Applications of catalysts

Industrially important catalysts and processes such as oxidation, processing of petroleum and hydrocarbons, synthesis gas and related processes, Environmental catalysis, Commercial catalytic reactors (fixed bed, fluidized bed, trickle-bed, slurry, etc.).

Heat and mass transfer and its role in heterogeneous catalysis. Calculations of effective diffusivity and thermal conductivity of porous catalysts. Reactor modeling. Emphasizes the chemistry processing of petroleum and hydrocarbons, synthesis gas and related processes, Environmental catalysis.

Reference books:

1. P.H. Emmet, Catalysis (Vol I and II), Reinhold, New York, 1954.
2. M. Schlosser, Organometallics in Synthesis, A manual, John Wiley, New York, 1996.
3. L.S. Hegedus, Transition Metals in the Synthesis of Complex Organic Molecules, University Science, Book, CA, 1999.
4. D.K. Chakrabarty and B. Viswanathan, Heterogeneous Catalysis, New Age, 2008.
5. B. Viswanathan, S. Kannan, R.C. Deka, Catalysts and Surfaces: Characterization Techniques, Narosa, New Delhi, 2010.
6. M. Kaneko, I. Okura, Photocatalysis: Science and Technology, Springer, 2003.
7. Text Book of Physical Chemistry Vol-1-4 by K.L. Kapoor
8. Physical Chemistry by D.N. Bajpai
9. Physical Chemistry by A.W. Atkins

MEDICINALCHEMISTRY

Subject Code: MCHMD1-312 | **L T PC 4 0 0 4** | **Duration: 60Hrs.**

Course Objectives

1. To understand types, classification, structural activity of various antibacterial, Antiviral and Antimalarialagent.
2. To know the synthetic procedures for Chloroquine, amodiaquine, mefloquine and sontoquine.
3. To familiarize with CNS depressant and CNSstimulants.
4. To know the synthetic procedure for thioridazine, haloperidol,diazepam.

Course Outcomes:

The students will be able to:

1. Understand the basics of drugs and drug receptor interactions
2. Learn the mechanism of action of drugs based on physicochemical factors and mode of synthesis of selected drugs..
3. Classify the drug molecules for clinical application based upon their mechanism of action.
4. Sketch the commercial synthetic routes and reaction mechanism of drugs under study

UNIT-I (15 Hrs.)

1. Antibacterial and Antiviral Agents

History of antibacterial drugs, types, classifications, structural activity relationship, fluoroquinolones. Mechanism of action of antibacterial, ß-lactams, bacterial resistance against antibacterial drugs. Target for anti HIV drugs, anti HIV agents, HIV-protease inhibitors, amprenavir, foseprenavir, alazanavir etc., anti-HIV nucleosides: lamivudine, retrovir, videx, hivid, zlarit, viread, carbovir, delavirdine, ziduvidine, etavirenz, calanolide, capravine, nevirapine. DNA polymerase inhibitors: acyclovir, ganciclovir, penciclovir, famicilovir, valaciclovir, valomaciclovir, codofvir.

UNIT-II(15 Hrs.)

2. Anti-malarials

Cinchona alkaloids, 4-aminoquinolines, 8-aminoquinolines, pyramidines and sulfones, 9-aminoacridines, biguanides, mefloquine, sulfonamides.

3. Commercial Synthetic Routes to

Chloroquine, pamaquine, primaquine, proguanil, amodiaquine, mefloquine, pyremethamine, sontoquine.

UNIT-III (15 Hrs.)

4. CNS Active Drugs: CNS depressants: Hypnotics and Sedatives

Barbiturates, non-barbiturates, amides and imides, glutethimide, benzodiazepines, aldehydes and derivatives, methaqualone and other miscellaneous agents.

5. Anticonvulsants

Barbiturates, hydanatoins, oxazolidinediones, succinimides, bezodiazepines, thenacemide, glutethimide.

6. CNS-Stimulants & Psychoactive Drugs

Analeptics, purines, psychomotor stimulants, sympathomimetics, monamine oxidase inhibitors, tricyclic antidepressants, miscellaneous psychomotor stimulants. Hallucinogens (psychedelics, psychometrics): Indolethylamines, R-phenylethylamines, butyrophenones and other miscellaneous drugs.

7. Commercial Synthetic Routes to

Thioridazine, haloperidol, chloropromazine, phenytoin, Phenobarital, Carbamazipinevalproic acid, methaquolane, nitrazepam, oxazepam, diazepam, cholridazepoxide.

UNIT-IV (15 Hrs.)

8. Diuretics

Osmotic agents, acidifying salts, mercurials, purines and related heterocycles, sulfonamides, benzothiadiazene and related compounds, chlorothiazides and analogs, sulfamoylebenzoic acid and analogs, endocrine antagonists, miscellaneous diuretics.

9. Commercial Synthetic Routesto

Furosemide, methalthiazidemethylchlothlazide: Chlorothiazide, triameterene, hydrochlothiazide, ameloride, chlorthalidone.

Recommended Books

1. Wilson and Gisvolds, 'Textbook of Organic Medicinal and Pharmaceuticals Chemistry', 8th Edn., edited by R.F. Deorge, J.B. Lippincott Company, Philadelphia,**1982**.
2. B.G. Reuben and H.A. Wittcoff, 'Pharmaceutical Chemicals in Perspective'**,** John Wiley & Sons, New York,**1989**.
3. W.O. Foye, T.L. Lamke, D.A. Williams, 'Principles of Medicinal Chemistry'**,** 5thEdn.Lippencott Williams and Wilkins,**2002**.

GREEN CHEMISTRY

Subject Code:MCHMD1-313 | **L T P C** 4 0 0 4 | **Duration: 60 (Hrs.)**

Course Objectives:

1. To understand the importance of ultrasound and microwaves in green synthesis
2. To learn the role of ionic liquids in green synthesis
3. To familiarize with phase transfer catalysis
4. To study the mechanistic aspect of aqueous phase reactions

Course Outcomes:

After completion of the course, students will be able to:

1. Understand the use of ultrasound/microwave in green reactions
2. Identify the role of utilization of ionic liquids in green syntheses
3. Explain the advantages of phase transfer catalysts

Write mechanistic aspects and use of selected aqueous phase reactions

UNIT-I (15 Hours)

Use of Ultrasound in Organic Synthesis:

Introduction, instrumentation, the phenomenon of cavitation, Sonochemical esterification, Saponification, Hydrolysis, Substitution Reactions, Addition Reactions, Alkylations, Oxidation, Reduction, Hydroboration, Coupling Reactions, Fridel-Crafts Reaction, Diels-Alder Reaction, Simon-Smith Reaction, Bouveault Reaction, Cannizaro Reaction, Strecker Synthesis, Reformatsky Reaction, Conversion of Ketones into Tertiary Alcohols, Synthesis of Chromenes.

Use of Microwaves in Organic Synthesis-Introduction, concept, reaction vessel and medium, advantages and limitations, Microwave Assisted Reactions in Water-Hofmann Elimination, Hydrolysis, Oxidation of Toluene, Oxidation of Alcohols. Microwave Assisted Reactions in Organic Solvents- Esterification, Fries Rearrangement, Diels Alder Reaction, Synthesis of Chalcones, Decarboxylation. Microwave Assisted Solvent Free Reactions (Solid State Reactions)- Alkylation of Reactive Methylene Compounds, Condensation of Active Methylene Compounds with Aldehydes, Synthesis of Nitriles from Aldehydes, Synthesis of Anhydrides from Dicarboxylic Acid, Reductions, Synthesis of Heterocyclic Compounds.

UNIT-II (15 Hours)

Ionic-liquids:

Introduction, structure, synthesis of some important ionic liquids, Applications of ionic liquids in Hydrogenations, Diel's-Alder Reaction, Heck Reaction, *O*-Alkylation and *N*-alkylation, Methylene Insertion Reactions, Miscellaneous Applications, Synthesis of Pharmaceutical Compounds.

Polymer supported Reagents in Organic Synthesis:

Introduction- properties of polymer support, advantages of polymer supported reagents Applications of Polymer Supported Reagents-Polymer Supported Peracids, Polymer Supported Chromic Acid, Polymeric Thioanisolyl Resin, Poly-*N*-Bromosuccinimide (PNBS), Polymeric Organotin Dihydride Reagent as a Reducing Agent, Polystyrene Carbodiimide, Polystyrene Anhydride, Sulfonazide Polymer, Polystyrene Wittig Reagent, Polymeric Phenylthiomethyl Lithium Reagent, Polymer Supported Peptide Coupling Agent. Polymer

Supported Catalysts-Polystyrene aluminium Chloride, Polymeric Super Acid Catalysts, Polystyrene-metalloporphyrins, Polymer Supported Photosensitizers.

UNIT-III (18 Hours)

Phase transfer catalysis and Crown Ethers :

Phase Transfer Catalysis: Introduction, definition, mechanism of phase transfer catalysis. Applications of PTC in Organic Synthesis- Nitriles from Alkyl or Acyl Halides, Alkyl Flurides from Alkyl Halides, Generation of Dihalocarbenes, Generation of Vinylidene Carbenes, Elimination Reactions, C-Alkylations, C-Alkylation of Activated Nitriles, C-Alkylation of Activated Ketones, C-Alkylation of Aldehydes, N-Alkylations, N-Alkylation of Aziridines, N-Alkylation of β-Lactams, S-Alkylation, Darzen's Reaction, Williamson's Ether Synthesis, Wittig Reaction, Sulphur Ylides.

Crown ethers: Introduction, nomenclature, features, nature of donor site. General synthesis of Crown ethers. Applications of crown ethers-Esterification, Saponification, Anhydride Formation, Potassium Permanganate Oxidation, Aromatic Substitution Reaction, Elimination Reaction, Displacement Reaction, Generation of Carbene, Superoxide Anion Reaction, Alkylation.

UNIT-IV (12 Hours)

Aqueous Phase Reactions:

Studies on the mechanistic aspects and use of the following reactions in organic synthesis: Diels-Alder Reaction, Claisen Rearrangement, Wittig-Homer Reaction, Michael Reaction, Aldol Condensation, Knoevenagel Reaction, Pinacol Coupling, Benzoin Condensation, Claisen-Schmidt Condensation, Heck Reaction, Strecker Synthesis, Wurtz Reaction, Expoxidation and Dihydroxylation, Oxidations and Reductions.

Recommended Text Books / Reference Books:

1. V.K. Ahluwalia and M. Kidwai, New trends in Green Chemistry, Anamaya Publishers, New Delhi, **2004**.
2. R. Sanghi and M.M. Srivastava, ‘Green Chemistry, Environment FriendlyAlternatives’, Narosa, New Delhi,**2003.**
3. ‘Green Chemistry-An Introduction Text’, Royal Society of Chemistry, UK,**2002**.
4. G.W. Gokel, ‘Crown Ethers & Cryptands’, Monograph, The Royal Society of Chemistry,**1991.**
5. G.W. Gokel, S.M. Korzeniowski, ‘Macrocyclic Polyether Chemistry’, Vol 1 to 3, Wiley, NY, **1978, 1981,1987**.
6. W.B. Weber, G.W. Gokel, ‘Phase Transfer Catalysis in Organic Synthesis’, Springer, Berlin, **1977**.
7. E.V. Dehmlov, S.S. Dehmlov, ‘Phase Transfer Catalysis’, 2nd Edn., VerlagChemie, Wienheim, **1983**.
8. N.K. Mathur, C.K. Narang and R.E. Williams, ‘Polymers as Aids in OrganicSynthesis’, Academic Press, NY,**1980**.

ORGANIC REACTION AND MECHANISM Lab - II

Subject Code: MCHMS1-305 | **L T P C** 0 0 4 2 | **Duration: 60(Hrs.)**

Note:
1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included.

Course Objectives:

1. To understand the synthesis procedure of some of the known organic molecules.
2. To introduce the basic techniques and procedures in isolation and purification of organic compounds
3. To learn physical and chemical characterization of the synthesized compounds.

Course Outcomes:

The students will be able to:

1. Understand the preparation methods of organic molecules.
2. Get hold of the theoretical understanding and practical skill of isolation and purification methods of synthesized molecules.
3. Evaluate the properties of synthesized organic products and their derivatives through spectroscopic and analytical tools.

1. **BeckmanRearrangement**
   a) Benzene-Benzophenone Benzophenone Oxime Benzanilide
   b) Benzene AcetophenoneAcetophenoneOxime-Acetanilide.
   c) CyclohexanoneOxime-Caprolactam.
2. **Benzylic acidRearrangement**
   a) Benzoin-Benzil-Benzylic-acid.
   b) Benzoin-Benzil-Benzilmonohydrazone.
3. **Fischer IndoleSynthesis**
   a) N-Arylmaleinilic acid N-arylmaleimide.
   b) 1, 2, 3, 4-Tetrahydrocarbazole.
   c) 2-Phenylindole fromPhenylhydrazone.
4. **Other OrganicPreparations**
   a) Cinnamic acid by Perkinreaction.
   b) Chalcone by aldolcondensation.
   c) Ethylp-aminobenzoate(benzocaine).
   d) Preparation of Benzopinacolone by Pinacol-Pinacolonerearrangement.
   e) Synthesis ofN-phenylmaleimide.
   f) Preparation ofp-bromoaniline fromacetanilide.
   g) Preparation of phenacetin fromp-aminophenol.
   h) Preparation of eosin from phthalicanhydride.
   i) Preparation of p-chlorobenzoic acid fromp-toluidine.

Recommended Text Books / Reference Books:

1. 'Vogel's Text Book of Practical Organic Chemistry'**,** 5th Edn., Prentice Hall,**1996**.
2. Julius B. Cohen, 'Practical Organic Chemistry'**,1910**.
3. David T. Plummer, 'An Introduction to Practical Biochemistry', 3rdEdn., TataMcGraw Hills,**1998**.
4. A.I. Vogel, 'Text Book of Practical Organic Chemistry', 5th Edn., PearsonEducation, **2005**.
5. P.R. Singh, D.S. Gupta and K.S. Bajpai, 'Experimental Organic Chemistry', Vol 2, Tata McGraw Hill, **1981**.
6. G. Mann and B.C. Saunders, 'Practical Organic Chemistry', ELBS Edn.,**1989**.
7. N.K. Vishnoi, 'Advanced Practical Organic Chemisry', 2nd Edn., Vikas PublishingHouse Pvt. Ltd.,**1994**.

PHYSICAL CHEMISTRY LAB – I

Subject Code: MCHMS1-306

L	T	P	C
0	0	4	2

Duration: 60(Hrs.)

Course Objectives:

1. To develop basic understanding of data analysis and reporting of results.
2. To calculate various physical parameters while performing experiments.
3. To learn the principles applicable to various experiments.
4. To introduce the handling of various instruments.

Course Outcomes:

The students will be able to

1. Report the result scientifically.
2. Prepare various solutions for quantitative analysis.
3. Understand the determination of various physical parameters.
4. Apply the concepts of physical phenomenon to chemical processes

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included.

Experiments

1. Determination of accuracy, precision, mean deviation, standard deviation, coefficient of variation, normal error curve and least square fitting of certain set of experimental data in an analysis. Composition of two sets of results in terms of significance (Precision and accuracy) by (i) student's t-test, (ii) F-test
2. Determination of ferrous ammonium sulfate potentiometrically with standard ceric sulfate solution (Direct and back titration).
3. To prepare a buffer solution of known ionic strength and to find its maximum buffer capacity.
4. Titrate a tribasic acid (phosphoric acid) against NaOH and $Ba(OH)_2$conductometrically.
5. To determine the equivalent weight of iron by the chemical displacement method. The equivalent weight of copper is 63.5.
6. Determination of partition coefficient of benzoic acid between benzene and water, and hence show that benzoic acid dimerises in benzene.
7. Determine the specific rate constant for the acid catalysed hydrolysis of methyl acetate by the Initial Rate Method.
8. Determination of surface tension of given liquid by drop no. method by stalagmometer.
9. Compare the strengths of hydrochloric acid and sulphuric acid by studying the rate of hydrolysis of methyl acetate.
10. To determine the composition of a mixture of two liquids by surface tension measurements.
11. Determine the equivalent conductance at infinite dilution for acetic acid by applying Kohlrausch's law (b) Determine the equivalent conductance, degree of dissociation and dissociation constant (Ka) of acetic acid.
12. To verify Freundlich and Langmuir Adsorption isotherms for adsorption of acetic acid on activated charcoal.
13. Study the conductometric titration of hydrochloric acid with sodium carbonate and determine the concentration of sodium carbonate in a commercial sample of soda ash.
14. Study the stepwise neutralization of a polybasic acid e.g. oxalic acid, citric acid, succinic acid by conductometric titration and explain the variation in the plots.
15. Titrate a moderately strong acid (salicylic/mandelic acid) by the (a) salt-line method (b) double alkali method.
16. Study the effect of dielectric constant (ε) on the nature of the conductometric titration between maleic acid and sodium methoxide using different mixtures of benzene and methanol as solvents.
17. Determine the dissociation constant of an indicator spectrophotometrically.
18. Verification of Beer's law and calculation of molar absorption coefficient using $CuSO_4$ and $KMnO_4$ solutions.
19. To determine the the equivalent conductance of a weak electrolyte at infinite dilution using Kohlraush law.
20. To study the current-potential characteristics of Cd^{2+} ions using DC polarography, sampled DC, cyclic voltammetry and pulse polarographic technique

Recommended Text Books / Reference Books:

1. A.I. Vogel, 'Vogel's Qualitative Inorganic Analysis', 7th Edn., (revised by G. Svehla) Longmans, 1996.
2. A.I. Vogel, 'Vogel's Textbook of Quantitative Chemical Analysis', 5th Edn., Longman, 1989.
3. F. Daniels, J.W. Williams, P. Bender, R.A. Alberty, C.D. Conwell & J.E. Harriman, 'Experimental Physical Chemistry', McGraw Hill, A.I. Vogel, 'Vogel's Qualitative Inorganic Analysis', 7th Edn., (revised by G. Svehla) Longmans, 1996.

4. A.I. Vogel, 'Vogel's Textbook of Quantitative Chemical Analysis', 5th Edn., Longman, 1989.
5. F. Daniels, J.W. Williams, P. Bender, R.A. Alberty, C.D. Conwell & J.E. Harriman, 'Experimental Physical Chemistry', McGraw Hill, 1962.
6. R.C. Das & B. Behera, 'Experimental Physical Chemistry', Tata McGraw Hill, Publishing Co. Pvt. Ltd., 1993.
7. D.P. Shoemaker, C.W. Garland & J.W. Nibler, 'Experiments in Physical Chemistry', McGraw Hill, New York, 1996.
8. R.A. Day, Jr. & A.L. Underwood, 'Quantitative Analysis', 3rd Edn. Prentice-Hall India Pvt. Ltd., New Delhi, 1977.
9. D.T. Burns & E.M. Ratenbury, 'Introductory Practical Physical Chemistry', Pergamon Press, 1966.
10. D.T. Burns & E.M. Ratenbury, 'Introductory Practical Physical Chemistry', Pergamon Press, 1966.
11. D.C. Harris, 'Quantitative Chemical Analysis', 6th Edn., W.H. Freeman & Co., 2002.

PHOTOCHEMISTRY AND PERICYCLIC REACTIONS

Subject Code: MCHMS1-401 **L T PC 4 0 0 4** **Duration: 60Hrs.**

Course Objectives

1. To provide the fundamental knowledge of photochemistry and pericyclic reactions.
2. To understand the concept of mechanism of photochemistry and pericyclic reactions.
3. To study the mechanistic aspect of pericyclic reaction to solve the reaction based problems.
4. To give the knowledge of applications of photochemical and pericyclic reactions in Organic synthesis..

Course Outcomes:

After completion of the course the student will able to

1. Acquire fundamental knowledge of pericyclic reactions and their mechanism.
2. Apply the principles of pericyclic reactions to solve the reaction based problems.
3. Understand the concept of mechanism of photochemistry.
4. Apply photochemical reactions in Organic synthesis..

UNIT-I (15 Hrs.)

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5- hexatriene, allylsystem, classification of pericyclic reactions, FMO approach. Woodward-Hoffmann correlation diagrams method and Perturbation of molecular orbital (PMO) approach for explanation ofpericyclic reactions under thermal and photo-chemical conditions.
Electrocyclic reactions – controtatory and disrotatory motions, 4n, 4n+2, allyl systems, Electrocyclic rearrangement of cyclobutenes and 1,3 cyclohexadienes.
Cycloadditions – antrafacial and suprafacial additions, notation of cylcoadditions (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+2) cycloaddition-stereochemicaleffects and effects of substituents on the rates of cycloadditions, 1,3-dipolar cyclo-additions.

UNIT-II (15 Hrs.)

Sigmatropic Rearrangements-suprafacial and antrafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and invertion of configuration, (3,3) and (5,5) sigma-tropic rearrangements, detailed treatment of Claisen and Cope rearrangements, fluxional tautomerism, aza-cope rearrangements, cheleotropic reactions, Ene and retro ene reactions, Ene and retro ene reactions, Coarctate reaction, simple problems on pericyclic reactions.

UNIT-III (15 Hrs.)

Introduction to organic photochemistry: Laws of photochemistry, Jablonski diagram

Photochemistry of Carbonul compounds: Primary photochemical reactions of n, π* states. Electronic energy transfer. Detail analysis of primary photochemical process of α-cleavage. Detail analysis of primary photochemical process of α- cleavage. Detail analysis of primary photochemical process of hydrogen abstraction. Detail analysis of primary photochemical process of electron transfer reactions. Norrish type-I and Norrish type –II reaction, Paterno Buchi Reaction.

UNIT-IV (15 Hrs.)

Primary photochemical reactions of π, π*states. Detail analysis of cis-trans isomerization. Study on di- π-methane rearrangement,Photochemistry of aromatic compounds, Photochemical reaction of azo compounds. Photochemical Oxygenations-Singlet Oxygen. Photochemistry of halogen containing compounds. Photoinduced electron transfer reactions. Factors influencing the course of photochemical reaction. Applications of photochemistry.

Recommended Books

1. J.C. Calvert and J.N. Pitts, Jr., 'Photochemistry', Wiley, New York,**1966**.
2. N.J. Turro, 'Modern Molecular Photochemistry', (MMP), University Press, Menlo Park, CA, **1978**.
3. A. Gilbert and J. Baggott, 'Essentials of Molecular Photochemistry', CRC Press,London, UK,**1991**.
4. J. Mattay and A. Griesbeck, eds., 'Photochemical Key Steps in Organic Synthesis', VCH, New York,**1994**.
5. J.D. Coyle, Edn., 'Photochemistry in Organic Synthesis', Royal Society ofChemistry, London,**1986**.
6. W.H. Horspool, Edn., 'Synthetic Organic Photochemistry', Plenum, New York,**1984**.
7. Bryce-Smith, et. al, eds. 'Specialist Reports of the Chemical Society: D. Photochemistry (Annual reports on all of photochemistry since1969)'.
8. I. Ninomiya and T. Naito, eds., 'Photochemical Synthesis', Academic Press,London, **1989**.
9. J.C. Scaiano, Edn., 'CRC Handbook of Organic Photochemistry', vol. 1 and 2, CRC Press, Boca Raton, Florida,**1989**.
10. JagdambaSingh and Jaya Singh, Photochemistry and pericyclic reaction New Age International Publication,**2019.**

BIO-INORGANICCHEMISTRY

Subject Code: MCHMS1-402	L T PC 4 0 0 4	Duration: 60 Hrs.

Course Objectives

1. To understand structures, processes and chemical interactions of enzymes with metalions in biological systems.
2. To understand the transport mechanisms of enzymes in physiologica lsystems.
3. To acquire knowledge of metal complexes with various nucleic acids.

Course Outcomes:

After completion of the course the student be will able to:

1. Understand the fundamental concepts related to bio inorganic chemistry.
2. Relate the fundamental concepts with the reactions of biomolecules.
3. Understand the reaction mechanisms and transport mechanisms of biomolecules .
4. Understand the importance of metals in biological metabolism.

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UNIT-I (15Hrs.)

Introduction, non-photosynthetic processes, structure of metallo-porphyrines, cytochromes, structure and function of haemoglobin, nature of heme-dioxygen binding, cooperativity in haemoglobin, Bohr effect and Heldane effect. physiology of myoglobin and haemoglobin, structure and function of myoglobin, comparision of haemoglobin and myoglobin.

UNIT-II (15Hrs.)

Structure and function, inhibition and poisoning Vitamin B12 and B12 coenzymes, nitrogen fixation, in-vitro and in-vivo nitrogen fixation, Nitrogenases, Other iron- prophyrin biomolecules, Peroxidase and catalases, cytochrome P450 enzymes. other natural oxygen carriers: hemerythrins, hemocyanine. Electron transfer system: respiration and photosynthesis, ferridoxins, and subredonim carboxypeptidase, carbonic anhydrase.

UNIT-III (15Hrs.)

Metal complexes of polynucleotides, nucleosides and nucleic acids (DNA & RNA). Template temperature, stability of DNA. Role of metal ions in replication and transcription process of nucleic acids. Biochemistry of calcium as hormonal messenger, muscle contraction blood clotting, neurotransmitter, calcification reclaiming of barren land.

UNIT-IV (15Hrs.)

Biochemistry of iron, iron storage and transport, ferritin transferring, bacterial iron transport, Bio-inorganic chemistry of Mo, W, V, Cr and Ni (essential and trace elements in biological systems). Metals in the regulation of biochemical events. Transport and storage of metal ions *in vivo*. metallothioneins.

Recommended Books

1. J.E. Huheey, E.A. Keiter and R.L. Keiter, 'Inorganic Chemistry: Principles of Structure and Reactivity', 4thEdn., HaperCollins.
2. B. Douglas, D. McDaniel and J. Alexander, 'Concepts and Models of Inorganic Chemistry', 3rdEdn., John Wiley andSons.
3. F.A. Cotton and G. Wilkinson, 'Advanced Inorganic Chemistry: A Comprehensive Text', 5TH EDN., JOHNWILEY.
4. Ch. Elschenbroich and A. Salzer, 'Organometallics. A Concise Introduction', 2ndEdn., VCH.
5. D.F. Shriver and P.W. Atkins, 'Inorganic Chemistry', 3rd Edn., Oxford UniversityPress.
6. J.A. Cowan, 'Inorganic Biochemistry', 2nd Edn.,Wiley-VCH.
7. G. Wulfsberg, 'Inorganic Chemistry', University ScienceBooks.
8. S.J. Lippard& J.M. Berg, 'Principles of Bioinorganic Chemistry',Univ. ScienceBooks, **1994**.
9. S.J. Lippard, 'Progress in Inorganic Chemistry', Vols. 18, 38, Wiley-Interscience,**1991**.

RESEARCH METHODOLOGY

Subject Code– MREM0-101 **L T PC** **Duration – 60 Hours**

4 0 0 4

UNIT–I (15 Hrs.)

Introduction to Research: Meaning, Definition, Objective and Process

Research Design: Meaning, Types - Historical, Descriptive, Exploratory and Experimental
Research Problem: Necessity of Defined Problem, Problem Formulation, Understanding of Problem, Review of Literature

Design of Experiment: Basic Principal of Experimental Design, Randomized Block, Completely Randomized Block, Latin Square, FactorialDesign.

Hypothesis: Types, Formulation of Hypothesis, Feasibility, Preparation and Presentation of Research Proposal

UNIT–II (15 Hrs)

Sources of Data: Primary and Secondary, Validation of Data

Data Collection Methods: Questionnaire Designing, Construction

Sampling Design & Techniques – Probability Sampling and Non Probability Sampling

Scaling Techniques: Meaning & Types

Reliability: Test – Retest Reliability, Alternative Form Reliability, Internal Comparison Reliability and Scorer Reliability

Validity: Content Validity, Criterion Related Validity and Construct Validity

UNIT–III (15 Hrs.)

Data Process Operations: Editing, Sorting, Coding, Classification and Tabulation

Analysis of Data: Statistical Measure and Their Significance, Central Tendency, Dispersion, Correlation: Linear and Partial, Regression: Simple and Multiple Regression, Skewness, Time series Analysis, Index Number

Testing of Hypothesis: T-test, Z- test, Chi Square, F-test, ANOVA

UNIT – IV (15 Hrs.)

Multivariate Analysis: Factor Analysis, Discriminant Analysis, Cluster Analysis, Conjoint Analysis, Multi Dimensional Scaling

Report Writing: Essentials of Report Writing, Report Format

Statistical Software: Application of Statistical Softwares like SPSS, MS Excel, Mini Tab or MATLAB Software in Data Analysis

**Each Student has to Prepare Mini Research Project on Topic/ Area of their Choice and Make Presentation. The Report Should Consists of Applications of Tests and Techniques Mentioned in The Above UNITs*

Recommended Books

1. R.I Levin and D.S. Rubin, 'Statistics for Management', 7th Edn., Pearson Education New Delhi.
2. N.K. Malhotra, 'Marketing Research–An Applied Orientation', 4th Edn., Pearson Education NewDelhi.
3. Donald Cooper, 'Business Research Methods', Tata McGraw Hill, NewDelhi.
4. Sadhu Singh, 'Research Methodology in Social Sciences', HimalayaPublishers.
5. Darren George & Paul Mallery, 'SPSS for Windows Step by Step', Pearson Education New Delhi.
6. C.R.Kothari, 'Research Methodology Methods & Techniques', 2nd Edn., New Age InternationalPublishers.

PHYSICAL CHEMISTRY LAB – II

Subject Code: MCHMS1-403

L	T	P	C
0	0	4	2

Duration: 60(Hrs.)

Course Objectives:

1. To develop basic understanding of various lab practices including safety measures.
2. To calculate various physical parameters while performing experiments.
3. To learn the principles applicable to various experiments.
4. To introduce the handling of various instruments.

Course Outcomes:

The students will be able to

1. Understand the determination of various physical parameters.
2. Connect the physical phenomenon to chemical processes.
3. Analyze multi-component systems.
4. Handle pH meter and spectrophotometer.

Note:
1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included.

Experiments

1. To determine the atomic parachor of C, H, Cl and Br by surface tension measurements.
2. Determination of heat of solution of a substance by solubility method.
3. To construct phase diagram of 3-component system (CH_3COOH + $CHCl_3$ + H_2O).
4. To prepare arsenious sulphide/Ferric hydroxide Sols and study Hardy – Schulze's rule for it.
5. To determine the relative strength of acids by study kinetics of hydrolysis of an ester.
6. To determine the iodine value of given sample of oil (Linseed oil).
7. To determine the saponification value of given sample of oil (Ground nut oil).
8. To obtain the mutual solubility curve of phenol + H_2O, and hence the Upper Consolute Point.
9. To determine parachor of a mixture of two liquids.
10. To determine the coefficient of viscosity of given liquid by Ostwald's viscometer.
11. To compare cleansing powers of two samples of detergent.
12. To determine the C.M.C. of a soap (sodium or potassium lauryl sulphate) by surface tension measurements
13. To determine the distribution coefficient of I_2 between CCl_4 and H_2O.
14. To study the variation of viscosity with composition of the mixture of liquids.
15. Determination of pH of a mixture of CH_3COOH and CH_3COONa, and hence to calculate dissociation constant of the acid.
16. To titrate Fe(II) with $KMnO_4$ spectrophotometrically.
17. To determine the composition of binary mixture containing $K_2Cr_2O_7$ and $KMnO_4$ using spectrophotometer.

18. To study the variation of solubility of $Ca(OH)_2$ in NaOH solution, and hence determine the solubility product.
19. Spectrophotometric determination (in ppm) of Fe (II) or Fe(III) using 1,10 Phenanthroline (or thiocyanate) as colorimetric reagent.
20. To investigate the autocatalytic reaction between potassium permanganate and oxalic acid.

Recommended Text Books / Reference Books:

1. 'Findlay's Practical PhysicalChemistry'.
2. J.B. Yadav, 'Advanced Practical PhysicalChemistry'.
3. L.V. Cock and C. van Rede, 'Laboratory Handbook for Oil & FatAnalysis'.
4. A.I. Vogel, 'Vogel's Textbook of Quantitative Chemical Analysis', 5th Edn., Longman, 1989.
5. F. Daniels, J.W. Williams, P. Bender, R.A. Alberty, C.D. Conwell & J.E. Harriman, 'Experimental Physical Chemistry', McGraw Hill, A.I. Vogel, 'Vogel's Qualitative Inorganic Analysis', 7th Edn., (revised by G. Svehla) Longmans, 1996.

DISSERATION

Subject Code: MCHMS1-404 **L T P C**
0 0 8 4

Course Objectives:

1. To familiarize the students with the modus operandi of literature survey.
2. To enable the students to choose the topic of the project.
3. To guide the students to carry out the project in the laboratory.
4. To compile the experimental work in the form of a dissertation.

Course Outcomes:

After completion of this course, students will

1. Know about different sections of a research article and learn the modus operandi of literature survey.

2. Be engaged in small research projects in pure / multidisciplinary areas of chemical sciences.

3. Acquire training for writing the project report and research article.

4. Be able to defend viva voce for their dissertation

M.Sc. 4th Semester will carry the dissertation work under the supervision of the assigned project guide as per following scheme:

Format for writing dissertation work: The students will write the report in Times New Roman, with font size 12 and 1.5 spacing.

1. Title of the M.Sc. Dissertation Work	7. Introduction
2. Self-Declaration Certificate of Original Work	8. Methodology

3. Acknowledgement	9. Results and Discussion
4. Content	10. Conclusion
5. List of Tables	11. References
6. List of Figures	12. Student's Bio data

Evaluation Criteria: The maximum marks allotted for the dissertation will be 100 which comprises of internal evaluation of 60 marks and external evaluation of 40 marks. The details of internal and external evaluation are given below:

(A) Internal Evaluation:(MM: 60)

The students will be evaluated based on regular performance, attendance and presentation.

He/She should give power point presentation of their detail work during the mid-semester ($1^{st}$and 2^{nd}) examinations.

Final Submission Report:

The student will submit the final report as hard bound copies (03) and soft copy on CD/DVD. The internal awards will be given to the students after final submission of the report by the dissertation supervisor.

(B) External Evaluation: (MM:40)

Evaluation will be done based on originality and quality of work, knowledge and presentation skills etc. The students should give presentation through power point slides in front of a internal panel of three examiners including dissertation Supervisor, Head/Nominee and other faculty member of the Department as constituted by Head of the Department.

TERM PAPER

Subject Code: MCHMS1-405 **L T P C**
0 0 8 4

Course Objectives:

1. To apprise the student with various components of a research article.
2. To familiarize the student with the modus operandi of literature survey.

3. To give the knowledge of review paper writing.

4. To write a small review paper on the selected topic.

Course Outcomes:

After completion of this course, students will:

1. Introduced to different sections of a research article

2. Learn the modus operandi of literature survey for a pre-defined topic.

3. Learn the art of writing a review paper.

4. Get training for defending viva voce for their term paper.

1. Evaluation of Term Paper will be internal and will be done by the three member Departmental Commttee constituted by HOD.

2. Four different heads have been classified for evaluation purpose and weightage is as follows:

(a) Literature survey 40%

(b) Writing of paper/format 20%.

(c) Presentation 20%

(d) Knowledge of subject 20%

3. Every student will submit hard copy of research papers reviewed by him/her for writing Term Paper.

4. Every teacher will give format of a particular journal to the student for writing the Term Paper.

5. A time slot will be provided in the time table to carry out literature survey for Term Paper. Permission can be sought from particular Institution to provide access to library facility, if needed by students.

6. The whole process of writing Term Paper will be a time bound activity and a time line will be framed with fixed dates and milestones.

ADVANCED LAB

Subject Code: MCHMS1-406

L	T	P	C
0	0	4	2

Duration: 60(Hrs.)

Course Objectives

1. To extract organic compound from natural sources
2. To synthesize organic molecules under sensitive reaction conditions
3. To prepare products, based on *a*, *b*- unsaturated compounds
4. To characterize synthesized products

After completion of the course, students will be able to:

1. Extract and identify organic compound from natural sources
2. Synthesize small organic molecules under sensitive reaction conditions
3. Prepare products, based on *a*, *b*- unsaturated compounds
4. Prepare and characterize aldol dehydration products

Note:
1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included.

EXPERIMENTS

1. **Extraction of organic compounds from naturalsources**
   a) Isolation of caffeine from tealeaves
   b) Isolation of piperine from blackpepper
   c) Isolation of lycopene from tomatoes
2. **Preparations:**
   a) Synthesis of anthranilic acid fromphthalimide.
   b) Preparation of 2-phenylindole fromphenylhydrazine.
   c) Synthesis of 2-phenyl-1,3,4-oxadiazole frombenzhydrazide
   d) Synthesis and reactivity of benzalacetophenone

3. Reactions of alkenesand *α*, *β*-unsaturated compounds

a) Bromination& subsequent debromination
b) Epoxidation and ring opening with hydroxide ion
c) Michael addition reactions of α, β-unsaturated compounds

4.Preparation and characterization of the Aldol-dehydration products *via* following aldehydes and ketones

a) Aldehydes:benzaldehyde, 4-methylbenzaldehyde, 4 methoxybenzaldehyde.

b) Ketones: acetone, cyclopentanons, cyclohexanone

RECOMMENDED BOOKS

1. L.M. Harwood and C.J. Moody, ‘Experimental Organic Chemistry’, 1st Edn., Blackwell Scientific Publishers,**1989**.
2. A.I. Vogel, ‘Textbook of Practical Organic Chemistry’, 6th Edn., ELBS, Longman Group Ltd.,**1978**.
3. F.G. Mann and B.C. Saunders, ‘Practical Organic Chemistry’, 4th Edn., New Impression, Orient Longman Pvt. Ltd.,**1975**.
4. A. Viswas and K.S. Tewari, ‘A Textbook of Organic Chemistry’, 3rd Edn.,Vikas Publishing House,**2009**.
5. J. Leonard and B. Lygo, ‘Advanced Practical Organic Chemistry’, Chapman andHall, **1995**.
6. W.L. Armarego and C. Chai, ‘Purification of Laboratory Chemicals’, Butterworth Heinemann,**2012**.
7. J.A. Young, ‘Improving Safety in the Chemical Laboratory: A Practical Guide’, 2nd Edn., Wiley Publishing,**1991**.

Total Marks= 800/900 **Total Credits= 23/24**

1st Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-101	Inorganic Chemistry-I	4	-	-	40	60	100	4
BCHMS1-102	Physical Chemistry-I	4	-	-	40	60	100	4
BCHMS1-103	Inorganic Chemistry-I **Lab**	-	-	4	60	40	100	2
BCHMS1-104	Physical Chemistry-I **Lab**	-	-	4	60	40	100	2
BHSMC0-042	Ability Enhancement Compulsory Course: English	2	-	-	40	60	100	2
Generic Elective I (Select any two with lab/tutorial as applicable)[a,b]								
BPHYS1-101	Electricity and Magnetism	4	-	-	40	60	100	4
BMCAS1 - 102	Introduction to Information Technology	3	1	-	40	60	100	4
BMATH5-101	Mathematics I*	3	1	-	40	60	100	4
BMATH5-102	Basic Mathematics I*							
BPHYS1-104	Electricity and Magnetism **Lab**		-	2	60	40	100	1
BMCAS1-105	Software Lab.-I (Based on BMCAS1-102)		-	2	60	40	100	1
	Total#		-	-	**380/440**	**420/460**	**800/ 900**	**23/24**

Note: (a): Each student has to opt two papers with lab/tutorial from the category of generic electives in each semester starting from semester I till semester IV from any two disciplines (mathematics, Physics, Computer Science). The disciplines once opted will remain same throughout the course.

*Students from Medical stream will study Basic Mathematics – I and Students from Non-Medical stream will study Mathematics – I

Depends on combination of electives selected by student.

Total Marks= 800/900 **Total Credits= 23/24**

2nd Semester			Contact Hrs.			Marks			Credits
Subject Code	**Subject**		**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-201	Organic Chemistry-I		4	-	-	40	60	100	4
BCHMS1-202	Physical Chemistry-II		4	-	-	40	60	100	4
BCHMS1-203	Organic Chemistry-I **Lab**		-	-	4	60	40	100	2
BCHMS1-204	Physical Chemistry-II **Lab**		-	-	4	60	40	100	2
BHSMC0-041	Ability Enhancement Compulsory Course	Environmental Sciences	3	-	-	40	60	100	3
BMNCC0-041		Drug abuse: problem, management and prevention	2	0	0	40	60	100	0
Generic Elective II (Select any two with lab/tutorial as applicable)[a,b]									
BPHYS1-201	Thermal Physics		4	-	-	40	60	100	4
BMCAS1- 403	Linux Operating System		3	1	-	40	60	100	4
BMATH5-201 **BMATH5-202**	Mathematics II* Basic Mathematics II*		3	1	-	40	60	100	4
BPHYS1-204	Thermal Physics Lab		-	-	2	60	40	100	1
BMCAS1- 406	Software Lab.-VIII (Based on BMCAS1-403)		-	-	2	60	40	100	1
Total#			**-**	**-**	**-**	**420/480**	**480/520**	**900/ 1000**	**24/25**

*Students from Medical stream will study Basic Mathematics – II and Students from Non Medical Stream will study Mathematics - II

Total Marks= 800/900 Total Credits= 23/24

3rd Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-301	Organic Chemistry-II	4	-	-	40	60	100	4
BCHMS1-302	Physical Chemistry-III	4	-	-	40	60	100	4
BCHMS1-303	Organic Chemistry-II **Lab**	-	-	4	60	40	100	2
BCHMS1-304	Physical Chemistry-III **Lab**	-	-	4	60	40	100	2
Skill enhancement course (Select any one)								
BCHMD1-311	Chemistry of cosmetics and perfumes	2	-	-	40	60	100	2
BCHMD1-312	Green Methods in Chemistry							
Generic Elective III(Select any two with lab/tutorial as applicable)[a,b]								
BPHYS1-302	Elements of Modern Physics	4	-	-	40	60	100	4
BMCAS1-104	Programming in C Language	3	1	-	40	60	100	4
BMATH5-301	Mathematics III	3	1	-	40	60	100	4
BPHYS1-306	Elements of Modern Physics Lab	-	-	2	60	40	100	1
BMCAS1-106	Software Lab.-II (Based on BMCAS1-104)	-	-	2	60	40	100	1
	Total#	-	-	-	**380/440**	**420/460**	**800/900**	**23/24**

Total Marks= 800/900 Total Credits= 23/24

4th Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-401	Inorganic Chemistry-II	4	-	-	40	60	100	4
BCHMS1-402	Organic Chemistry-III	4	-	-	40	60	100	4
BCHMS1-403	Inorganic Chemistry-II **Lab**	-	-	4	60	40	100	2
BCHMS1-404	Organic Chemistry-III **Lab**	-	-	4	60	40	100	2
Skill enhancement course (Select any one)								
BCHMD1-411	Fuel Chemistry	2	-	-	40	60	100	2
BCHMD1-412	Pharmaceutical Chemistry							
Generic Elective IV (Select any two with lab/tutorial as applicable)[a,b]								
BPHYS1-202	Waves and Optics	4	-	-	40	60	100	4
BMCAS1-204	Object Oriented Programming Language in C++	3	1	-	40	60	100	4
BMATH5-401	Mathematics IV	3	1	-	40	60	100	4
BPHYS1-205	Waves and Optics Lab	-	-	2	60	40	100	1
BMCAS1-207	Software Lab.-IV (Based on BMCAS1-204)	-	-	2	60	40	100	1
Total[#]		**-**	**-**	**-**	**380/440**	**420/460**	**800/ 900**	**23/24**

Total Marks= 1000 Total Credits= 26

5th Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-501	Inorganic Chemistry-III	4	-	-	40	60	100	4
BCHMS1-502	Organic Chemistry-IV	4	-	-	40	60	100	4
BCHMS1-503	Physical Chemistry-IV	4	-	-	40	60	100	4
BCHMS1-504	Inorganic Chemistry-III **Lab**	-	-	4	60	40	100	2
BCHMS1-505	Organic Chemistry-IV **Lab**	-	-	4	60	40	100	2
BCHMS1-506	Physical Chemistry-IV **Lab**	-	-	4	60	40	100	2
Discipline Specific Elective – I (Select any two with lab)								
BCHMD1-511	Applications of Computers in Chemistry	3	0	0	40	60	100	3
BCHMD1-512	Instrumental methods of analysis	3	0	0	40	60	100	3
BCHMD1-513	Novel Inorganic Solids	3	0	0	40	60	100	3
BCHMD1-514	Applications of Computers in Chemistry **Lab**	-	-	2	60	40	100	1
BCHMD1-515	Instrumental methods of analysis **Lab**	-	-	2	60	40	100	1
BCHMD1-516	Novel Inorganic Solids **Lab**	-	-	2	60	40	100	1
Total		**-**	**-**	**-**	**500**	**500**	**1000**	**26**

Total Marks= 1000 Total Credits= 26

6th Semester		Contact Hrs.			Marks			Credits
Subject Code	**Subject**	**L**	**T**	**P**	**Internal**	**External**	**Total**	
BCHMS1-601	Physical Chemistry – V	4	-	-	40	60	100	4
BCHMS1-602	Inorganic Chemistry – IV	4	-	-	40	60	100	4
BCHMS1-603	Organic Chemistry – V	4	-	-	40	60	100	4
BCHMS1-604	**Physical Chemistry – V Lab**	-	-	4	60	40	100	2
BCHMS1-605	**Inorganic Chemistry – IV Lab**	-	-	4	60	40	100	2
BCHMS1-606	**Organic Chemistry V – Lab**	-	-	4	60	40	100	2
Discipline Specific Elective – I (Select any two with lab)								
BCHMD1-611	Polymer Chemistry	3	0	0	40	60	100	3
BCHMD1-612	Molecular modelling and drug design	3	0	0	40	60	100	3
BCHMD1-613	Inorganic materials of Industrial Importance	3	0	0	40	60	100	3
BCHMD1-614	Polymer Chemistry Lab	-	-	2	60	40	100	1
BCHMD1-615	**Molecular modelling and drug design lab**	-	-	2	60	40	100	1
BCHMD1-616	Inorganic materials of Industrial Importance Lab	-	-	2	60	40	100	1
Total		**-**	**-**	**-**	**500**	**500**	**1000**	**26**

Semester	Marks	Credits
1st	**900/ 1000**	**23/24**
2nd	**800/ 900**	**23/24**
3rd	**800/ 900**	**23/24**
4th	**800/ 900**	**23/24**
5th	**1000**	**26**
6th	**1000**	**26**
Total	5300/5700	144/148

INORGANIC CHEMISTRY-I

SUBJECT CODE–BCHMS1-101 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives
1. To familiarize with atomic structure, quantum numbers and shapes of orbitals
2. To understand periodic table and periodicity of elements and their effect on various properties of elements
3. To understand the concept of various bonding theories
4. To understand importance of redox reactions

Course Outcomes: The completion of this course will make student to acquire the knowledge of:
1. Wave mechanics, atomic theories and shapes of orbitals
2. Periodic table and various periodic properties
3. Ionic bond, covalent bond, metallic bond and various weak chemical forces
4. Redox reactions and applications of redox reactions

Unit I **(14 Lectures)**

Atomic Structure:
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: deBroglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f*orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

Unit II **(16 Lectures)**

Periodicity of Elements:
s, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to *s* &*p*-block.
(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.
(b) Atomic radii (van der Waals)
(c) Ionic and crystal radii.
(d) Covalent radii (octahedral and tetrahedral)
(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.
(f) Electron gain enthalpy, trends of electron gain enthalpy.
(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

Unit III **(12 Lectures)**

Chemical Bonding I:
(i) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points.
(ii) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Unit IV **(18 Lectures)**

Chemical Bonding II:

(i) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach).Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ioniccharacter from dipole moment and electronegativity difference.

(ii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

Oxidation-Reduction:

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Reference Books:

• Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
• Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry,Oxford, 1970
• Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.
• Day, M.C. and Selbin, J. Theoretical Inorganic Chemistry, ACS Publications 1962.

PHYSICAL CHEMISTRY I

SUBJECT CODE–BCHMS1-102 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives

1. To familiarize with the basic phenomenon/concepts of equation of state and properties of liquids and solids.

2. To understand the nature of solid state, crystal systems and defects in crystals.

3. To understand the concept of ionisation, pH and hydrolysis.

4. To familiarise with the role of equilibrium in electrolytic action.

Unit I **(8 Lectures)**

Gaseous stateI:
Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation;collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.

Unit II **(10 Lectures)**

Gaseous stateII:
Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, *Z*, and its variation with pressure for different gases. Causes of deviation from ideal behaviour. Van der Waals equation of state, its derivation and application in explaining real gas behaviour, mention of other equations of state (Berthelot, Dietrici); virial equation of state; van der Waals equation expressed in virial form and calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding
states.

Unit III **(6 Lectures)**

Liquid state:
Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Solid state: **(16 Lectures)**
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law. Detailed discussion of defects in crystals. Glasses and liquid crystals.

Unit IV **(20 Lectures)**

Ionic equilibria:

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).

Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body.

Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of acid–base indicators; selection of indicators and their limitations. Multistage equilibria in polyelectrolyte systems; hydrolysis and hydrolysis constants

Course Outcomes: On completion of this course students will be able to:

1. Comprehend the kinetic modular model of gases, behaviour of ideal and real gases.
2. Apply the concept of equilibrium to understand the behaviour of ions in solution.
3. Analyse a solid and its defects for their applications.
4. Relate different states of matter with their observable properties.

Reference Books:

• Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press13(2006).
• Ball, D. W. Physical Chemistry Thomson Press, India (2007).
• Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).
• Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP (2009).

INORGANIC CHEMISTRY LAB I

SUBJECT CODE-BCHMS1-103 **L T P C** **0 0 4 2** **(60 Lectures)**

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To familiarize with solution preparation.
3. To understand acid-base and oxidation reduction titrimetry.

EXPERIMENTS

(A) Titrimetric Analysis

(i) Calibration and use of apparatus

(ii) Preparation of solutions of different Molarity/Normality of titrants

(B) Acid-Base Titrations

(i) Estimation of carbonate and hydroxide present together in mixture.

(ii) Estimation of carbonate and bicarbonate present together in a mixture.

(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry

(i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution.

(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.

(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Course Outcomes: The students will acquire knowledge of:

1. Preparation of solutions
2. Estimation of carbonates, bicarbonates and free alkalis in solution with acid base titrations
3. Estimation of Fe(II) and oxalic acid with oxidation reduction titrimetry

Reference text:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

PHYSICAL CHEMISTRY LAB-I

SUBJECT CODE-BCHMS1-104 **L T P C** **(60 Lectures)**
0 0 4 2

Course Objectives

1. To develop basic understanding of various lab practices including safety measures.
2. To familiarize with basics of the phenomenon of surface tension and viscosity.
3. To understand the principle of pH metric titrations.
4. To familiarize with preparation of buffer solutions of different pH values.

1. Surface tension measurements.
a. Determine the surface tension by (i) drop number (ii) drop weight method.
b. Study the variation of surface tension of detergent solutions with concentration.
2. **Viscosity measurement using Ostwald's viscometer**.
a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.
b. Study the variation of viscosity of sucrose solution with the concentration of solute.
3. Indexing of a given powder diffraction pattern of a cubic crystalline system.
4. pH metry
a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
b. Preparation of buffer solutions of different pH
i. Sodium acetate-acetic acid
ii. Ammonium chloride-ammonium hydroxide
c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.
d. Determination of dissociation constant of a weak acid.
Course Outcomes: The students will be able to:

1. Carry out measurement of surface tension and viscosity of solutions.
2. Prepare buffer solutions of different pH values.
3. Handle pH meter.
4. Apply pH metric titrations for various determinations.

Reference Books

• Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
• Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed*.; McGraw-Hill: New York (2003).
• Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003

ENGLISH

SUBJECT CODE– BHSMC0-042 **L T P C** **(30 Lectures)**
2 0 0 2

Course Objectives

1. To remove the phobia of conversing in English.
2. To make the learners enable to express themselves among peers & teachers.
3. To enable learners, improve their vocabulary.
4. To introduce them with basic communicative skills in real life situations.
5. To enhance learner's writing ability.

UNIT-I (8 Hours)

Communication Skills: Introduction, Definition, the Importance of Communication,
The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context
Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

UNIT-II (7 Hours)

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment.
Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

UNIT-III (7 Hours)

Communication Styles: Introduction, The Communication Styles Matrix with example for each Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style.
Basic Listening Skills: Introduction, Self-Awareness, Active Listening, becoming an Active Listener, Listening in Difficult Situations

UNIT-IV (8 Hours)

Interview Skills: Purpose of an interview, Do's and Don'ts of an interview
Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery
Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion.

Course Outcomes:
The student will acquire mastery in English
including writing; formal writing, letters, e'Dcoumentation and Reading. Especially in Communication Skills through G.D's, Public speaking and Situational Dialogues.

Reference Books:

1. Ruther Ford A. J., 'Basic Communication Skills for Technology', 2nd Edition, Pearson Education,2011.
2. Kumar S. and Pushplata, 'Communication Skills', 1st Edition, Oxford Press,2011.
3. Stephen P. Robbins, 'Organizational Behaviour', 1st Edition, Pearson,2013.
4. Gill H., 'Brilliant-Communication Skills', 1st Edition, Pearson Life,2011.
5. Gopalawamy R., 'The Ace of Soft Skills: Attitude, Communication and Etiquettefor Success', 5thEdition, Pearson, 2013.
6. Dalley D., Burton L. and Margaret G., 'Developing your Influencing Skills', Green Hall, 1 st Edition, Universe of Learning LTD,2010.
7. Konarnira, 'Communication Skills for Professionals', 2nd Edition, PHI,2011.

8. Mitra B. K., ‘Personality Development and Soft Skills’, 1st Edition, Oxford Press,2011.
9. ‘Soft Skill for Everyone’, Butter Field, 1stEdition, Cengage Learning India Pvt. Ltd., 2011.
10. Francis Peters S.J., ‘Soft Skills and Professional Communication’, 1st Edition, McGraw HillEducation, 2011.
11. John A., ‘Effective Communication’, 4th Edition, Pan MacMillan, 2009.
12. Aubrey D., ‘Bringing out the Best in People’, 2nd Edition, McGraw Hill,1999

ELECTRICITY AND MAGNETISM

Subject Code: BPHYS1-101 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective:

To understand the basic concepts of electricity and magnetism.

To provide knowledge of Dielectric, Magnetic properties of matter and Electromagnetic induction and Electric circuits.

Course Outcomes:

1. Understanding the concepts of electric field, magnetic field, potentials, dielectric and magnetic properties of matter, electromagnetic induction and electric circuits.
2. Skill enhancement to solve numerical problems related with Electricity and Magnetism.
3. Apply knowledge of Electricity and Magnetism to go for higher studies in diverse fields.
4. To inculcate and develop the ability to think abstractly.

UNIT-I (15 Hours)

Electric Field and Electric Potentials

Electric field: Electric field lines. Electric flux. Gauss’ Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace’s and Poisson equations. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor.

UNIT-II (15 Hours)

Magnetic Field and Electric Potentials

Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart’s Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere’s Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements.

UNIT-III (15 Hours)

Dielectric and Magnetic Properties of Matter

Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

UNIT-IV(15 Hours)

Electromagnetic induction and Electric circuits

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and Band Width. Parallel LCR Circuit. Network theorems: Ideal Constant-voltage and Constant-current Sources. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem.

Recommended Text Books / Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw.
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education.
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
6. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

INTRODUCTION TO INFORMATION TECHNOLOGY

Subject Code: BMCAS1--102 **L T P C** **3 1 0 4** **(60 Lectures)**

Course Objectives:

1. To understand the basics of Computer Languages,Computer Network and Communication.
2. To define the memory types,input/output devices,storage devices,computer generations.
3. To get familiar with Operating System,Word processing and number system
4. To understand the Internet Applications and Presentation Graphics Software

Course Outcomes: The completion of this course will make student to acquire the knowledge of:

1. Working on different software for word processing, powerpoint presentation, spreadsheets and communicate ideas electronically.
2. Designing page layouts for digital and electronic publications by combining different media elements.
3. Basic concepts and terminology of information technology.
4. Personal computers and their operations.

UNIT- I (14 Lectures)

Computer Fundamentals: Block structure of a computer, characteristics of computers, problem solving with computers, generations of computers, and classification of computers on the basis of capacity, purpose, and generation.

Number System: Bit, byte, binary, decimal, hexadecimal, and octal systems, conversion from one system to the other, representation of characters, integers and fractions.
Binary Arithmetic: Addition, subtraction and multiplication.

UNIT-II (15 Lectures)

Memory Types: Magnetic core, RAM, ROM, Secondary, Cache, Bubble Memory.
Input and Output Units: Keyboard, Mouse, Monitor (CRT and LCD): Light pen, joystick, Mouse, Touch screen; OCR, OMR, MICR
Overview of storage devices: Floppy disk, hard disk, compact disk, tape. Printers: Impact, non-impact, working mechanism of Drum printer, Dot Matrix printer, Inkjet printer and Laser printer.
Computer Languages: Machine language, assembly language, higher level language, 4GL. Introduction to Compiler, Interpreter, Assembler, Assembling, System Software, Application Software.

UNIT- III (17 Lectures)

Operating System: Batch, multi-programming, time sharing, network operating system, on-line and real time operating system, Distributed operating system, multi-processor, Multi-tasking.
Graphical OS: Fundamentals of windows, types of windows, anatomy of windows, windows explorer, customizing windows, control panel, taskbar setting, Network Neighborhood.
Word processing: Editing features, formatting features, saving, printing, table handling, page settings, spell-checking, macros, mail-merge and equation editors.
Spreadsheet: Workbook, worksheets, data types, operators, cell formats, freeze panes, editing features, formatting features, creating formulas, using formulas, cell references, replication, sorting, filtering, functions, Charts & Graphs.
Presentation Graphics Software: Templates, views, formatting slide, slides with graphs, animation, using special

features, presenting slide shows.

UNIT –IV **(14 Lectures)**

Computer Network and Communication: Network types, network topologies, network communication devices, physical communication media.

Internet and its Applications: E-mail, TELNET, FTP, World Wide Web, Internet chatting; Intranet, Extranet, Gopher, Mosaic, WAIS.

Recommended Books:

1. D. H. Sanders, 'Computers Today', 4th Edn., McGraw Hill, **1988**.
2. V. Rajaraman, 'Fundamentals of Computers', 2nd Edn., Prentice Hall of India, New Delhi, **1996**.
3. Satish Jain, 'Information Technology', BPB, Paperback Edn., **1999**.
4. David Cyganski, John A. Orr, 'Information Technology Inside and Outside', Pearson Education, Paperback Edn., **2002**.
5. B. Ram, 'Computer Fundamentals', 3rd Edn., Wiley, **1997**.
6. ChetanSrivastva, 'Fundamentals of Information Technology', 3rd Edn., KalayaniPublishers.
7. Larry long & Nancy long, 'Computers', 12th Edn., PrenticeHall, **1999**.

MATHEMATICS-I

SUBJECT CODE –BMATH5-101 **L T P C** **(60 Lectures)**
31 0 4

Course Objective:

Define and interpret the concepts of Matrices and Determinants
To learn Vector Calculus, Vector Differentiation, Vector Integration.

Course Outcome

Students will be able to assess:

1. To implement the idea of system of linear equations
2. Use vector and scalar product in terms of area and volume
3. To implement the idea of vector differentiation, divergence and curl of vector field
4. To implement the idea of vector integration with its theorems

UNIT-I **(15 Lectures)**

Algebra of matrices, Inverse and rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II **(14 Lectures)**

Vector Calculus: Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations, Vector product, Scalar triple product and their interpretation in terms of area and volume respectively, Scalar and Vector fields.

UNIT-III **(16 Lectures)**

Vector Differentiation: Directional derivatives and normal derivative, Gradient of a scalar field and its geometrical interpretation, Divergence and curl of a vector field, Del and Laplacian operators, Vector identities.

UNIT-IV **(15 Lectures)**

Vector Integration: Ordinary Integrals of Vectors, Multiple integrals, Notion of infinitesimal line, surface and volume elements, Line, surface and volume integrals of Vector fields, Flux of a vector field, Gauss' divergence theorem, Green's and Stokes Theorems (Without proofs) and their applications.

References Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
3. Murray R. Spiegel, Vector Analysis, Schaum publishing Company, New York.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
6. Peter Baxandall , Hans Liebeck , 'Vector Calculus', Dover Publications; 2008 edition.

BASIC MATHEMATICS-I

Subject Code: BMATH5-102 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objective:

To explain the concepts of limit and continuity, function

To learn Maxima and Minima, Rules of Differentiability integration.

Course Outcome:

Students will be able to assess:

1. Get knowledge about the basic concept of limit continuity,Differentiability ,nth derivative of well-known functions
2. To determine Rolle's theorem, Mean Value Theorems and various type of Tracing of curves
3. Tracing of Cartesian curves, parametric and polar curves
4. Able to solve applications of definite integral

.

UNIT-I **(15 Lectures)**

Basic concept of limit and continuity, Properties of limit and classification of discontinuities, Properties of continuous functions, Differentiability and differentials, Successive differentiation and Leibnitz theorem, Derivatives of higher order, nth derivative of well-known functions.

UNIT-II **(13 Lectures)**

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x , log(l+x), $(l+x)^m$, Maxima and Minima, Indeterminate forms, Curvature, Asymptotes, Singular points, Tracing of curves, tracing of curves in polar and Parametric forms.

UNIT-III **(16 Lectures)**

Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, properties of definite integral.

UNIT-IV **(16 Lectures)**

Applications of Definite Integrals, Plane Area, Arc Length, Areas between Curves, Centroids, Moments of Inertia, Volumes, Reduction formulae for integrals of rational, trigonometric, exponential and logarithmic function and of their combinations.

Course Outcome: On successful completion of the course, students will be able to assess properties implied by the Properties of continuous functions, Differentiability and differentials, Tracing of curves, tracing of curves in polar and Parametric forms, Method of Partial fractions, Applications of Definite Integral.

Books Recommended

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.
3. Zafar Ahsan: Differential Equations and Their Applications, Second Edition, PrenticeHall of India Private Limited, New Delhi.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Erwin Kreyszig: Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

ELECTRICITY AND MAGNETISM LAB

ubject Code: BPHYS1-104 **L T P C** **Duration: 30 Hrs.**
21

Course Objective:

To learn practically the various concepts of electricity and magnetism.

The course will provide hands- on training to the students for handling various electrical instruments.

Course Outcome:

- Able to verify the concepts/laws of Electricity and Magnetism.
- To inculcate and develop scientific aptitude by performing the various experiments.
- Skill enhancement by solving experimental problems.
- To inculcate the spirit of team work.

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

List of Experiments:-

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.

8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
12. Determine a high resistance by leakage method using Ballistic Galvanometer.
13. To determine self-inductance of a coil by Rayleigh's method.
14. To determine the mutual inductance of two coils by Absolute method.

Recommended Text Books / Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

SOFTWARE LAB-I (BASED ON BMCAS1--102)

Subject Code: BMCAS1--105 | **L T P C** | **(30 Lectures)**

0 0 2 1

Course Objectives:

1. To introduce IT in a simple language to students.
2. To help students to pursue specialized programs leading to technical and professional careers and certifications in the IT industry
3. To introduce skills relating to IT basics, computer applications, programming, interactive medias and Internet basics
4. To understand the concept of Computer's Input/output devices, the concept of dynamic memory, data types, loops, functions, array, pointers, string, structures and files.

Course Outcomes:

After completion of the course students will be able to:

1. Understand basic concepts and terminology of information technology.
2. Understand the working of spreadsheets and create their own powerpoint presentations
3. Know about Ms-Word and its features.
4. Work with the latest tools of information technology.

ORGANIC CHEMISTRY-I

SUBJECT CODE -BCHMS1-201 **L T P C** **(60 Lectures)**
31 0 4

Course Objectives

1. To understand the concepts behind basics of organic chemistry
2. To familiarize with the general mechanisms of organic reactions and bonding between organic molecules
3. To comprehend the applicability of organic reactions and organic molecules
4. To make the students apprehend the recognition of organic compounds and organic reaction mechanism

Unit I **(6 Lectures)**

Basics of Organic Chemistry
Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, influence of hybridization on bond properties.
Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit II **(18 Lectures)**

Stereochemistry:
Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.
Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers,Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemicmixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Unit III **(16 Lectures)**

Chemistry of Aliphatic Hydrocarbons
Carbon-Carbon sigma bonds
Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.
Carbon-Carbon pi bonds:
Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.
Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.
Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Unit IV **(20 Lectures)**

Cycloalkanes and Conformational Analysis
Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.
Aromatic Hydrocarbons
Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with theirmechanism. Directing effects of the groups.

Course Outcomes:
Students will be able to:
1. Understand the basics of organic chemistry
2. Analyze the general mechanisms of organic reactions and bonding between organic molecules
3. Comprehend the applicability of organic reactions and organic molecules
4. Recognise the type of organic compounds and organic reaction mechanism

Reference Books:

• Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
• Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
• Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

PHYSICAL CHEMISTRY-II

SUBJECT CODE–BCHMS1-202 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives

To familiarize the student with the basic concepts of thermodynamics.
To elaborate the system of variable composition and their properties.
To understand the concept of chemical equilibrium.
To understand the concept of solutions and colligative properties.

Unit I **(18 Lectures)**

Chemical Thermodynamics I:
Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.
First law: Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.
Thermochemistry: Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Unit II **(18 Lectures)**

Chemical Thermodynamics II:
Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.
Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.
Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Unit III **(16 Lectures)**

Systems of Variable Composition:
Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Chemical Equilibrium:
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Unit IV **(8 Lectures)**

Solutions and Colligative Properties:
Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

Course Outcomes: On completion of this course, students will be able to:
1. Identify and describe energy exchange processes.
2. Manipulate physical parameters to favour a particular process.
3. Compare the system properties with variation in composition.
4. Explain the behaviour of solutions.

Reference Books

• Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.*, Oxford University Press (2011).
• Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
• Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).
• McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
• Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
• Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
• Metz, C.R. *2000 solved problems in chemistry*, Schaum Series (2006)

ORGANIC CHEMISTRY LAB I

SUBJECT CODE-BCHMS1-203 **L T P C** **(60 Lectures)**
0 0 4 2

Course Objectives

1. To understand the concepts behind calibration and purification by crystallization method.
2. To familiarize with the procedures to determine the physicochemical properties and effect of impurities on these properties
3. To understand the basics of chromotagraphic methods of separation of mixtures.

1. Checking the calibration of the thermometer
2. Purification of organic compounds by crystallization using the following solvents:
a. Water
b. Alcohol
c. Alcohol-Water
3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds
5. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
6. Chromatography
a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
b. Separation of a mixture of two sugars by ascending paper chromatography
c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Course Outcomes:
After completion of course students will be able to:
1. Purify organic compounds using various solvent combinations and calibrate small instruments.
2. Determine melting and boiling points of various organic compound
3. Separate organic mixtures using chromatographic techniques

Reference Books

• Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
• Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)

PHYSICAL CHEMISTRY LAB II

SUBJECT CODE-BCHMS1-204 **L T P C** **(60 Lectures)**
0 0 4 2

Course Objectives

1. To understand the determination of heat capacity.
2. To familiarize with the enthalpy of a reaction.
3. To understand the use of a calorimeter for determination of heat capacity.
4. To correlate physical phenomena with their heat exchange.

Thermochemistry

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

(f) Determination of enthalpy of hydration of copper sulphate.

(g) Study of the solubility of benzoic acid in water and determination of ΔH.

Course Outcomes: The students will be able to:

1. Handle calorimeter.
2. Determine the heat capacity.
3. Determine enthalpy of different processes.
4. Determine heat of neutralization of an acid with a base.

Reference Books

• Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

• Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age International: New Delhi (2001).

ENVIRONMENTAL SCIENCE

Subject Code: BHSMC0-041 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives:

1. To familiarize the student with the basic concept of Environmental and Environmental Chemistry.
2. To elaborate the ecosystem and their properties.
3. To understand the concept of Environmental Pollution and its diverse effect of pollution.
4. To understand the concept of sustainable and unsustainable development and its importance.

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

CO1: Understand the basics of Environment chemistry
CO2: Analyze the general concept of ecosystem and their components.
CO3: Comprehend the applicability of social issues and Environment.
CO4: Recognize the Environment Pollution and control measures of urban and industrial wastes.

Unit-I (08 Hours)

The Multidisciplinary nature of environmental studies, Natural Resources: Renewable and non-renewable resources

Unit-II (15 Hours)

Natural resources and associated problems: a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-III (12 Hours)

Ecosystems, Concept of an ecosystem, Structure and function of an ecosystem, Introduction, types, characteristic features of the ecosystems (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit- IV (10 Hours)

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books:

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
5. Clark R.S., Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd. 8. Down of Earth, Centre for Science and Environment

DRUG ABUSE: PROBLEM, MANAGEMENT AND PREVENTION

Subject Code: BMNCC0-041 **L T P C** **Duration: 30Hrs.**
2 0 0 0

UNIT-I (6 Hours)

Meaning of Drug Abuse: Meaning: Drug abuse, Drug dependence and Drug addiction. Nature and extent of drug abuse in India and Punjab.

UNIT-II (8 Hours)

Consequences of Drug Abuse: Individual: Education, Employment, Income. Family: Violence. Society: Crime. Nation: Law and Order problem.

UNIT-III (8 Hours)

Prevention of Drug Abuse: Role of Family: Parent-child relationship, Family support, supervision, shipping values, active scrutiny. School: Counselling, Teacher as role-model, Parent-teacher-health professional coordination, Random testing on students.

UNIT-IV (8 Hours)

Treatment and Control of Drug Abuse: Medical Management: Medication for treatment and to reduce withdrawal effects. Psychological Management: Counselling, Behavioural and Cognitive therapy. Social Management: Family, Group therapy and Environmental intervention. Treatment: Medical, Psychological and Social Management. Control: Role of Media and Legislation.

Recommended Books:

1. Ram Ahuja, 'Social Problems in India', Rawat Publications, Jaipur, 2003.
2. 'Extent, Pattern and Trend of Drug Use in India', Ministry of Social Justice and Empowerment, Govt. of India, 2004.
3. J.A. Inciardi, 'The Drug Crime Connection', Sage Publications, Beverly Hills, 1981.
4. T. Kapoor, 'Drug Epidemic among Indian Youth', Mittal Publications, New Delhi, 1985.
5. Kessel, Neil and Henry Walton, 'Alcoholism, Harmond Worth', Penguin Books, 1982.
6. Ishwar Modi and Shalini Modi, 'Addiction and Prevention', Rawat Publications,Jaipur, 1997.
7. 'National Household Survey of Alcohol and Drug Abuse', Clinical Epidemiological Unit, All India Institute of Medical Sciences, New Delhi, 2003 &2004.
8. Ross Coomber and Others, 'Key Concept in Drugs and Society', Sage Publications, New Delhi,2013.
9. Bhim Sain, 'Drug Addiction Alcoholism, Smoking Obscenity', Mittal Publications, New Delhi,1991.
10. Ranvinder Singh Sandhu, 'Drug Addiction in Punjab: A Sociological Study', Guru Nanak Dev University, Amritsar, 2009.
11. Chandra Paul Singh, 'Alcohol and Dependence among Industrial Workers', Shipra,Delhi, 2000.
12. S.Sussman and S.L. Ames, 'Drug Abuse: Concepts, Prevention andCessation', Cambridge University Press, 2008.
13. P.S. Verma, 'Punjab's Drug Problem: Contours and Characteristics', Vol. LII, No. 3, P.P. 40-43, Economic and Political Weekly, 2017. 1
14. 'World Drug Report', United Nations Office of Drug and Crime, 2016.

'World Drug Report', United Nations Office of Drug and Crime,2017

THERMAL PHYSICS

Subject Code: BPHYS1-201 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objective:

To provide a detailed knowledge of laws of thermodynamics,
T understand the applications of laws of thermodynamics, and Maxwell's thermodynamic relations.

Course Outcomes:

To understand the concepts related to Thermal Physics and their applications.
Skill enhancement to solve numerical problems related with the laws of thermodynamics, entropy, and Maxwell's thermodynamic relations.
Apply knowledge of Thermal Physics to go for higher studies in diverse fields.
To inculcate and develop the ability to think abstractly.

UNIT-I (15 Hours)

Laws of Thermodynamics

Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem.

UNIT-II (15 Hours)

Applications of laws of thermodynamics

Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

UNIT-III (15 Hours)

Entropy

Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.

UNIT-IV (15 Hours)

Thermodynamic Potentials and Maxwell's relations

Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Surface Films and Variation of Surface Tension with Temperature. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations (6) Change of Temperature during Adiabatic Process.

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. Statistical Physics and Thermodynamics, V.S. Bhatia, 1990, Shoban Lal Nagin Chand.
3. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
5. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University.
6. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

LINUX OPERATING SYSTEM

Subject Code: BMCAS1—403 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objectives:

1. To teach principles of operating system including basic Linux commands.
2. To facilitate students in understanding Inter process communication.
3. To understand and make effective use of linux utilities and shell scripting language to solve problems
4. To Develop the skills the necessary for systems programming including file system programming,process and signal management .

Course Outcomes:

After completion of course students will be able to:

1. Understand the basic commands of linux operating system and can write shell scripts.
2. Create file systems and directories and operate them.
3. Create processes background and fore ground etc..by fork() system calls.
4. Create shared memory segements,pipes ,message queues and can exercise interprocess communication

UNIT- I **(14 Lectures)**

Introduction to Operating Systems: its needs and services, Simple batch Systems, Multi- programmed batched systems, Time sharing systems, Parallel systems, Distributed systems and Real-time systems. Introduction to process, Process States.

Structure of LINUX: Kernel, Shell. LINUX Directory system.

UNIT- II **(15 Lectures)**

LINUX Commands: User Access and User ID Commands, Directory commands, Editors Commands, File Manipulation Commands, Security and Protection Commands, Inter-User and Inter-Machine Communication, Process Management Commands, I/O Redirection and Piping Commands, Vi editor, File Handling commands, and Introduction to Regular Expressions and Grep.

UNIT- III **(17 Lectures)**

Administering LINUX System: Introduction to System Administration, Functional activities of System Administration - Starting up the system, Maintaining the Super User Login, shutting down the system, recovering from system crash, taking backups, managing disk space, Mounting and Un-mounting file system, Adding and removing users, Changing groups and password.

UNIT- IV **(14 Lectures)**

Shell Programming: Executing a shell program, Study of shell programming as a Language; Wild card characters, Type of statements and Reserved Words, Special Shell parameters. The AWK pattern scanning and processing language: Operators, Control Statements and arrays.

Recommended Books:

1. J. Goerzen," Linux Programming Bible", IDG Books, New Delhi**.**
2. N. Mathew&R. Stones,"Beginning Linux Programming", Wiley Publishing India.

MATHEMATICS-II

Subject Code: BMATH5-201 **L T P C** **(60 Lectures)**
31 0 4

Course Objective:

1. To provide the basic Knowledge of Probability spaces, Basic Statistics, Sequence and Series, Partial differentiation.

UNIT-I **(14Lectures)**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables;

UNIT-II **(15Lectures)**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

UNIT-III **(15Lectures)**

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Cauchy's Integral test, series of positive and negative terms); Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT-IV **(16Lectures)**

Partial differentiation –Function of two variables, Partial derivatives of higher order, Homogeneous functions, Euler's theorem and its extension (with proof), Composite functions, Total derivative, Differentiation of implicit functions and composite functions, Jacobians and its properties.

Course Outcome: After the completion of the course, the students will able to :

1. Apply the concept and consequences of Probability and Measures of Central tendency:
2. Understand moments, skewness and Kurtosis Binomial, Poisson and Normal Probability

distributions also concepts of correlation

3. To demonstrate the idea convergence of sequence and series, tests for convergence,power series and to represent function as series.
4. Extend the knowledge of Partial derivatives of higher order for further exploration of the subject for going into higher education.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
4. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.
5. S.C. Gupta and V.K. Kapoor ,Fundamentals of Applied Statistics,4th Edition, Sultan Chand & Sons, 2014.

BASIC MATHEMATICS-II

Subject Code: BMATH5-202 **L T P C** **(60 Lectures)**
3 1 0 4

Course Objective:

To define and interpret the concepts of Matrices and Determinants, Sequence and Series, Partial differentiation, Partial derivatives.

UNIT-I **(14Lectures)**

Matrices and Determinants: Algebra of matrices, Inverse and rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II **(15Lectures)**

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, Ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Cauchy's Integral test, series of positive and negative terms); Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

UNIT-III **(16Lectures)**

Partial differentiation –Function of two variables, Partial derivatives of higher order, Homogeneous functions, Euler's theorem and its extension (with proof), Composite functions, Total derivative, Differentiation of implicit functions and composite functions, Jacobians and its properties.

UNIT-IV **(15Lectures)**

Partial derivatives, directional derivatives, total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers.

Course Outcome: After the completion of the course, the students will be able

1. Understand the basic concepts of matrices and determinants in order to explore the advance study of theoretical problems of linear algebra.
2. To demonstrate the idea convergence of sequence and series, tests for convergence,power series and to represent function as series.
3. Extend the knowledge of Partial derivatives of higher order for further exploration of the subject for going into higher education.
4. Apply derivatives for the computation of directional derivative and Optimization.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
4. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
5. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

THERMAL PHYSICS LAB

Subject Code: BPHYS1-204 **L T P C** **(30 Lectures)**

0 0 2 1

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective:

To learn practically the various concepts of thermodynamics.

The course will provide hand on training to the students for handling various related instruments.

Course Outcome:

- Practical knowledge of concepts of Thermodynamics.
- To inculcate and develop scientific aptitude by performing the various experiments.

- Learn to draw conclusions from data and develop skills in experimental design.
- To inculcate the spirit of teamwork

List of Experiments:-

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
7. To calibrate a thermocouple to measure temperature in a specified Range using Null Method
8. To calibrate a thermocouple to measure temperature in a specified Range using Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

Reference Books

1 Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2 A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3 Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4 A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

SOFTWARE LAB VIII (BASED ON BMCAS1-403 LINUX OPERATING SYSTEM)

Subject Code: BMCAS1--406 **L T P C** **0 0 2 1** **Duration: 30 Lectures**

Course Objectives

1. To describe the basic file system in Linux and its file attributes.
2. To Appraise different filters, process handling, regular expressions and network handling features using suitable commands.
3. To Summarize different Linux commands to write Shell Programs
4. To demonstrate use of system calls

Course Outcomes: After completion of course students will be able to:

1. Demonstrate installation of Linux operating system and understand the importance of Linux
2. Manage shell and processes using various commands.
3. Demonstrate Linux administration and its environment.
4. Write Shell scripts and C programs using vi editor

ORGANIC CHEMISTRY-II

SUBJECT CODE -BCHMS1-301 **L T P C** **4 0 0 4** **(60 Hrs.)**

Course Objectives

1. To understand the concepts behind basics of organic chemistry

2. To familiarize with concepts behind reaction intermediates
3. To understand the mechanism of various organic reactions
4. To describe concepts of preparation and properties of functional group derivatives

Course Outcomes:

After the completion of course, students will be able to:

1. Describe chemistry of functional groups

2.Use of reaction intermediates in organic reactions

3. Sketch mechanism of various organic reactions

4. Explain the concepts of preparation and properties of functional group derivatives

Unit I **(16 Hrs.)**

Chemistry of Halogenated Hydrocarbons:

Alkyl halides: Methods of preparation, nucleophilic substitution reactions – SN1, SN2 and SNi mechanisms with stereochemical aspects and controlling factors, Comparison of nucleophilic substitution and elimination reactions.
Aryl halides: Preparation (including preparation from diazonium salts). Nucleophilic aromatic substitution; SNAr, Benzyne mechanism.
Relative reactivity of alkyl, allyl/benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.
Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.

Unit II **(16 Hrs.)**

Alcohols, Phenols, Ethers and Epoxides:

Alcohols: Preparation, properties and relative reactivity of 1°, 2°, 3°alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement.
Phenols: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism.
Ethers and Epoxides: Preparation and reactions with acids. Reactions of epoxides with alcohols, ammonia derivatives and $LiAlH_4$

Unit III **(14 Hrs.)**

Carbonyl Compounds:

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisan-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, MPV and PDC); Addition reactions of unsaturated carbonyl compounds: Michael addition.
Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.

Unit IV **(14 Hrs.)**

Carboxylic Acids and their Derivatives:

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic, phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids; Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation,

Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.

Sulphur containing compounds:
Preparation and reactions of thiols, thioethers and sulphonic acids.

Reference Books:
1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt.Ltd. (Pearson Education)2010.
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson Education)2002.
3. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.,2016.

PHYSICAL CHEMISTRY-III

SUBJECT CODE –BCHMS1-302 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objectives

1. To familiarize the student with the basic concepts of chemical kinetics.
2. To elaborate the concept of phases and phase equilibria.
3. To understand the concept of various surface phenomena and adsorption isotherms.
4. To understand various adsorption isotherms.

Course Outcomes: On completion of this course students will be able to:

1. Apply the knowledge of catalysis and its mechanism in reactions.
2. Predict and control the rate of formation of products/reactants based on concept of chemical kinetics.
3. Explain the reason for reaction rates on the basis of theories and mechanisms.
4. Identify and analyse uni/multicomponent systems.

Unit I **(12 Hrs.)**

Phase Equilibria-I:
Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systemswith applications.

Unit II **(14 Hrs.)**

Phase Equilibria-II:
Phase diagrams for systems of solid-liquid equilibria involving eutectic, congruent andincongruent melting points, solid solutions.
Binary solutions: Gibbs-Duhem-Margules equation, its derivation, azeotropes, partial miscibility of liquids, CST, miscible pairs, steam distillation.
Nernst distribution law: its derivation and applications.

Unit III **(20 Hrs.)**

Chemical Kinetics :
Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism.

Unit IV **(14 Hrs.)**

Catalysis:

Types of catalyst, specificity and selectivity, effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

Surface chemistry:

Physical adsorption, chemisorption, adsorption isotherms.

Reference Books

1. Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.*, Oxford University Press (2011).
2. Castellan, G. W. *Physical Chemistry 4th Ed.*, Narosa (2004).
3. Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.*, Prentice-Hall (2012).

4. McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd. (2004).
5. Puri, B. R.; Sharma, L. R.&Pathania, M. S.; *Principles of Physical Chemistry.*Vishal Publishing (2011).
6. Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
7. Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006)
8. Zundhal, S.S. *Chemistry concepts and applications* Cengage India (2011).
9. Ball, D. W. *Physical Chemistry* Cengage India (2012).
10. Mortimer, R. G. *Physical Chemistry 3rd Ed.,* Elsevier(2009).

ORGANIC CHEMISTRY LAB II

SUBJECT CODE-BCHMS1-303 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To understand synthesis of various organic compounds
2. To determine the melting points of organic compounds
3. To understand the use of thin layer chromatography
4. To understand chemistry involved in functional group determination

Course Outcomes:

After completion of course students will be able to:

1. Prepare prepare small organic compounds
2. Make use of melting point apparatus
3. Comparison of various organic compounds on thin layer chromatography
4. Analyze and detect organic functional groups

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included

Experiments

1. Functional group tests for alcohols, phenols, carbonyl and carboxylic acid group.
2. Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, *o*-, *m*-, *p*-toluidinesand *o*-, *m*-, *p*-anisidine) and phenols (β-naphthol, vanillin, salicylicacid) by any one method:
a. Using conventional method.
b. Using green approach
ii Benzolyation of one of the following amines (aniline, *o*-, *m*-, *p*- toluidines and *o*-,*m*-, *p*-anisidine) and one of the following phenols (β-naphthol, resorcinol, p-cresol)by Schotten-Baumann reaction.
iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
iv. Bromination of any one of the following:
a. Acetanilide by conventional methods
b. Acetanilide using green approach (Bromate-bromide method)
v. Nitration of any one of the following:
a. Acetanilide/nitrobenzene by conventional method
b. Salicylic acid by green approach (using ceric ammonium nitrate).
vi. Selective reduction of *meta* dinitrobenzene to *m*-nitroaniline.

vii. Reduction of *p*-nitrobenzaldehyde by sodium borohydride.
viii. Hydrolysis of amides and esters.
ix. Semicarbazone of any one of the following compounds: acetone, ethyl methylketone, cyclohexanone, benzaldehyde.
x. *S*-Benzylisothiouronium salt of one each of water soluble and water insoluble acids(benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid).

xi. Aldol condensation using either conventional or green method.

xii. Benzil-Benzilic acid rearrangement.
The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education(2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and* QuantitativeAnalysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: QualitativeAnalysis,* University Press (2000).

PHYSICAL CHEMISTRY LAB III

SUBJECT CODE-BCHMS1-304 **L T P C** **(60 Hrs.)**
0 0 4 2

1. **Course Objectives**
2. 1. To understand phase rule and phase diagram.
3. 2. To familiarize with various adsorption isotherms.
4. 3. To introduce the concept of critical solution temperature.
5. 4. To understand the kinetics of a reaction practically.

Course Outcomes: The students will be able to:
1. Construct the phase diagram and calculate various parameters associated with the phase concept.
2. Study kinetics of a reaction practically.
3. Apply adsorption isotherm to study adsorption phenomena.
4. Compare the strengths of acids.

Note:
1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2 Any other subject related experiment can also be included

Experiments

I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it.
II. Phase equilibria: Construction of the phase diagram using cooling curves or ignition tube method:
a. simple eutectic and
b. congruently melting systems.
III. Distribution of acetic/ benzoic acid between water and cyclohexane.
IV. Study the equilibrium of at least one of the following reactions by the distribution method:
(i) $I_2(aq) + I^- \rightarrow I^{3-}(aq)$
(ii) $Cu^{2+}(aq) + nNH_3 \rightarrow Cu(NH_3)_n$
V. Study the kinetics of the following reactions.
1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
a. Acid hydrolysis of methyl acetate with hydrochloric acid.
b. Saponification of ethyl acetate.
3. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methylacetate.
VI. Adsorption
1. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid onactivated charcoal.

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003)

CHEMISTRY OF COSMETICS AND PERFUMES

Subject Code: BCHMD1-311 **L T P C** **(30 Hrs.)**
2 0 0 2

Course Objectives

1.To provide the significance of everyday usage of cosmetics and fundamental principles related to it..
2.3.To give an overview of cosmetic ingredients and different types of stability tests of finished products.
To familiarise the students with the chemical aspect of the cosmetics and safety measures required while applying the cosmetic product..

Course Outcomes: After completion of this course, the students will :

1.Know the significance and fundamentals of cosmetics of everyday use.
2.Have an overview of cosmetic ingredients, quality & stability testing of the finished product..
3.Understand the cosmetics from the chemical perspective and its safety measures.Students will be able to prepare some cosmetics on their own.

Unit-I **(7 Hrs.)**

Cosmetics through the Ages, Formulations of cosmetics for everyday use, A general studyincluding preparation and uses of hair care products: Hair dye, hair spray, shampoo, Skin preparations: creams (cold, vanishing and shaving creams).

Unit-II **(8 Hrs.)**

Colouring materials used in decorative cosmetics and colour matching, preparation and uses ofdecorative products: face powder, lipsticks, talcum powder, nail enamel.Sun damage and Sunscreen preparations.

Unit-III **(7 Hrs.)**

Quality, stability and safety assurance of cosmetics: analytical methods, efficacy testing of cosmetics, emulsion theory, microbiological control of cosmetics, hazard determination of ingredients, stability testing.

Unit-IV **(8 Hrs.)**

Perfumes**:** 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.

Practicals (any two)

1. Preparation of shampoo.
2. Preparation of nail polish and nail polish remover.
3. Preparation of cold creams.
4. Preparation of glycerine soap.

Reference Books:

1. *Handbook of Cosmetic Science and Technology* Edited by: Edited by André O. Barel, Marc Paye, Howard I. Maibach, 3rd edition
2. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK (1990).
3. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi.
4. Sharma, B.K. & Gaur, H. *Industrial Chemistry,* Goel Publishing House, Meerut (1996).

GREEN METHODS IN CHEMISTRY

Subject Code: BCHMD1-312 **L T P C** **(30 Hrs.)**
2 0 0 2

Course Objectives :

1. To learn principles of green chemistry.
2. To familiarize with real world case studies related to green chemistry

Course Outcomes:

After completion of the course, students will be able to:

1. Explain principles of green chemistry
2. Define applications of green chemistry in industry

Tools of Green chemistry, Twelve principles of Green Chemistry, with examples.

The following Real world Cases in Green Chemistry should be discussed:
1 A green synthesis of ibuprofen which creates less waste and fewer by-products (Atomeconomy).
2 Surfactants for Carbon Dioxide – replacing smog producing and ozone depletingsolvents with CO_2 for precision cleaning and dry cleaning of garments.
3 Environmentally safe antifoulant.
4 CO_2 as an environmentally friendly blowing agent for the polystyrene foam sheetpackaging market.
5 Using a catalyst to improve the delignifying (bleaching) activity of hydrogenperoxide.
6 A new generation of environmentally advanced preservative: getting the chromiumand arsenic out of pressure treated wood.
7 Rightfit pigment: synthetic azopigments to replace toxic organic and inorganicpigments.
8 Development of a fully recyclable carpet: cradle to cradle carpeting.

<u>Reference Books:</u>

1. Manahan S.E. (2005) Environmental Chemistry, CRC Press
2. Miller, G.T. (2006) Environmental Science 11th edition. Brooks/Cole
3. Mishra, A. (2005) Environmental Studies. Selective and Scientific Books, New Delhi

ELEMENTS OF MODERN PHYSICS

Subject Code: BPHYS1-302 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objective:

1. To learn and understand basic concepts of Quantum Mechanics
2. To understand the concepts of Nuclear Physics, Laser and its Applications.

Course Outcomes:

- Understanding the basic concepts in the development of modern physics.
- To establish the basic foundation of students to study the advance level course like quantum physics, particle physics and high energy physics.
- Skill enhancement to solve numerical problems related with basic quantum, nuclear and particle physics.
- To provide the knowledge of the state-of-the-art of modern days lasers and their applications in daily life.

UNIT-I(15 Hours)

Introduction to Quantum Mechanics

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

UNIT-II (15 Hours)

Quantum Mechanical Uncertainty

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction. Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence.

UNIT-III (15 Hours)

Nuclear Physics

Constituents of nucleus and their intrinsic properties, Qualitative facts about size, mass, density, energy, charge. Binding energy, angular momentum, magnetic moment and electric quadruple moments of the nucleus, Wave mechanical properties of nucleus, average binding energy and its variation with mass numbers, Properties of nuclear forces, Non existence of electrons in the nucleus and neutron-proton model, Liquid drop model and semi empirical mass formula, Conditions of nuclear stability.Radioactivity. Modes of decay and successive radioactivity. Alpha emission. Electron emission, Positron emission. Electron capture, Gamma-ray emission, Internal conversion.

UNIT-IV(15 Hours)

Laser and its Applications

Introduction**,** Coherence**,** Spatial and temporal coherence,Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Einstein's A and B coefficients. Three-Level and Four-Level Lasers. Components of Laser, Types of Laser: Ruby Laser and He-Ne Laser, Semiconductor Laser and CO_2 Laser. Q-switching, Mode locking, Applications of lasers–a general outline. Basics of holography.

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan

PROGRAMMING IN C LANGUAGE

Subject Code: BMCAS1-104 **L T P C** **(60 Hrs.)**
3 1 04

Course Objectives:

1. To help the students in finding solutions to various real life problems.
2. To convert the solutions into computer program using C language (structured programming).
3. To understand a functional hierarchical code organization.
4. To design and develop modular programming.

Course Objectives Outcomes:

1. Students will learn to write algorithm for solutions to various real- life problems.
2. Students will learn to convert the algorithms into computer programs using C language.
3. Students will implement different Operations on arrays, functions, pointers, structures, unions and files

UNIT- I **(14 Hrs.)**

Algorithm and Programming Development: Steps in development of a program, Flow charts, Algorithm Development, Program Debugging, Compilation and Execution.

Fundamentals of 'C': I/O statements, Assignment Statements, Constants, Variables, Operators and Expressions, Standards and Formatted statements, Keywords, Data Types and Identifiers.

UNIT- II **(15 Hrs.)**

Control Structures: Introduction, Decision making with if – statement, if-else and Nested if, while and do-while, for loop. Jump statements: break, continue, goto, switch Statement

Functions: Introduction to Functions, Function Declaration, Function Categories, Standard Functions, Parameters and Parameter Passing, Call – by value/reference, Recursion, Global and Local Variables, Storage classes.

UNIT- III **(17 Hrs.)**

Arrays: Introduction to Arrays, Array Declaration, Single and Multidimensional Array, Memory Representation, Matrices, Strings, String handling functions.

Structure and Union: Declaration of structure, Accessing structure members, Structure Initialization, Arrays of structure, nested structures, Unions.

UNIT- IV **(14 Hrs.)**

Pointers: Introduction to Pointers, Address operator and pointers, Declaring and Initializing pointers, Assignment through pointers, Pointers and Arrays

Files: Introduction, creating a data file, opening and closing a data file, processing a data file.

Preprocessor Directives: Introduction and Use, Macros, Conditional Preprocessors, Header Files.

Recommended Books:

1. Yashvant P. Kanetkar, 'Let us C', 7thEdn., BPB Publications, NewDelhi,**2010**.
2. E. Balagurusami, 'Programming in ANSI C', 4thEdn., Tata McGrawHill, **2007**.
3. Byron S. Gottfried, 'Programming in C', 2ndEdn.,McGrawHills, **1998**.
4. Kernighan & Richie, 'The C Programming Language', 2ndEdn.,PHIPublication, **1988**.
5. R. Lafore, 'Object Oriented Programming', 3rdEdn.,GalgotiaPublications, **1999**.
6. R.S. Salaria, 'Problem Solving and Programming in C', 2ndEdn, **2015**.

MATHEMATICS-III

Subject Code: BMATH5-301 **L T P C** **(60 Hrs.)**
3 1 0 4

Course Objective:

1. To introduce concept of ordinary and partial differential equations.

Course Outcome:

Students will be able to:

1. Apply various methods to Solve first and second order linear ordinary differential equations.
2. Solve the linear partial differential equations using various methods and apply these methods in solving some physical problems.
3. Understand the formation and solution of some significant PDEs like wave equation, heat equation and Laplace equation.
4. Apply differential equations to significant applied and theoretical problems.

UNIT-I(14 Lectures)

First Order Ordinary Differential Equations: Linear and Bernoulli's equations, exact equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT-II(16 Lectures)

Ordinary Differential Equations of higher Orders: Second order linear differential equations with variable coefficients, (complementary function, particular integral) method of variation of parameters, Cauchy-Euler equation.

UNIT-III(15 Lectures)

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method, Second-order linear equations and their classification.

UNIT-IV(15 Lectures)

Separation of variables in a PDE; wave and heat equations in one dimensional form, Elementary solutions of Laplace equations.

Reference Books:

1. G.B. Thomas and R.L. Finney, 'Calculus and Analytic Geometry', 9th Edn., Pearson, Reprint, 2002.
2. Erwin Kreyszig, 'Advanced Engineering Mathematics', 9th Edn, John Wiley & Sons,2006.
3. T. Veerarajan, 'Engineering Mathematics for First Year', Tata McGraw Hill, New Delhi, 2008.
4. B.V. Ramana, 'Higher Engineering Mathematics', 11th Reprint, Tata McGraw Hill, New Delhi, 2010.
5. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

ELEMENTS OF MODERN PHYSICS LAB

Subject Code: BPHYS1-306 **L T P C** **(30 Hrs.)**
0 0 2 1

Note:

1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective:

To understand practically the laws of Modern Physics.

The course will provide hand on training to the students for handling various related instruments.

Course Outcomes:

- Able to verify the concepts/laws of basic quantum, nuclear and particle physics.
- To inculcate and develop scientific aptitude by performing the various experiments.
- Skill enhancement by solving experimental problems.
- To inculcate the spirit of teamwork.

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.
10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

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, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

SOFTWARE LAB II (BASED ON BMCAS1-104 PROGRAMMING IN C LANGUAGE)

Subject Code: BMCAS1-106 **L T P C** **Duration (30 Hrs.)**
0 0 2 1

Course Objectives:

1. The objective of this course is to help the students in finding solutions to various real life problems
2. To convert the solutions into computer program using C language (structured programming).

Course Outcomes:

Students will learn to write programs for solving various real- life problems.

1. **Input-Output Statements:** formatted and non-formattedstatements.
2. **Decision Making:** switch, if-else, nested if, else-if ladder, break, continue, goto.
3. **Loops:** while, do-while, for.
4. **Functions:** definition, declaration, variable scope, parameterized functions, return statement, call by value, call by reference, recursivefunctions.
5. **Arrays:** Array declarations, Single and multi-dimensional, memory limits, strings and string functions.
6. **Files:** Creation and editing of various types of files, closing a file (using functions and without functions).

INORGANIC CHEMISTRY-II

SUBJECTCODE -BCHMS1-401 **L T PC 4 0 0 4** **(60 Hrs.)**

Course Objectives

1. To understand the principles of metallurgy
2. To familiarize with the concepts of acids and bases
3. To understand the concepts behind chemistry of s & p block elements
4. To learn the chemistry behind noble gases and inorganic polymers

Course Outcomes:

After the completion of course students will have:

1. Comprehend the metallurgy principles with various refining processes
2. understand chemistry of s and p block elements
3. have an overview of noble gases and inorganic polymers

UnitI **(14 Hrs.)**

General Principles of Metallurgy:

Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagramsforreduction of metal oxides using carbon and carbon monoxide as reducing agent. ElectrolyticReduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Partingprocess, van Arkel-de Boer process and Mond's process, Zone refining.

Acids and Bases:

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids,types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification ofLewis acids, Hard and Soft Acids and Bases (HSAB), Application of HSAB principle.

UnitII **(13 Hrs.)**

Chemistry of *s* and *p* Block Elements-I:

Inert pair effect, Relative stability of different oxidation states, diagonal relationship andanomalous behavior of first member of each group. Allotropy and catenation. Complexformation tendency of *s* and *p* block elements.Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate andnitrate.

UnitIII(17 Hrs.)

Chemistry of *s* and *p* Block Elements-II (Continued Unit II):

Study of the following compounds with emphasis on structure, bonding, preparation,properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acidsof sulphur, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

UnitIV **(16 Hrs.)**

Noble Gases:

Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation andproperties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valencebond treatment and MO treatment for XeF_2). Molecular shapes of noble gas compounds(VSEPR theory).

Inorganic Polymers:

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, andpolysulphates.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry*, ELBS, 1991.
2. Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models ofInorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.
3. Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-Heinemann. 1997.
4. Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
5. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning IndiaEdition, 2002.
6. Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
7. Atkin, P. *Shriver & Atkins' Inorganic Chemistry 5th Ed*. Oxford University Press,2010.

ORGANIC CHEMISTRY-III

SUBJECTCODE -BCHMS1-402 **L T P C** **4 0 0 4** **(60** Hrs.)

Course Objectives:

1.To provide the knowledge of Organic Chemistry and fundamental principles related to it..
2.To give an overview of reactivity and properties of various Organic compounds. .
3.To familiarise the students with the applications of the Organic compounds.

Course Outcomes: After completion of this course, the students will :

1.Know the significance and fundamentals of Organic compounds.
2.Have an overview of reactivity and properties of Organic copounds..
3.Understand the applications of Organic compounds in medicinal field.

UnitI **(18 Hrs.)**

Nitrogen Containing Functional Groups:

Preparation and important reactions of nitro and compounds, nitriles and isonitriles.Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, Carbylamine reaction, Mannich reaction, Hoffmann's exhaustive emethylation, Hofmann-elimination reaction; Distinction between 1°, 2°and 3°amines withHinsberg reagent and nitrous acid.Diazonium Salts: Preparation and their synthetic applications.

UnitII **(15 Hrs.)**

Polynuclear Hydrocarbons:

Reactions of naphthalene, phenanthrene and anthracene. Structure, Preparation and structureelucidation and important derivatives of naphthalene and anthracene; Polynuclear hydrocarbons.

Heterocyclic Compounds-I:

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered ringscontaining one heteroatom; Synthesis, reactions and mechanism of substitution reactions of:Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis),Thiophene,

Unit III(15 Hrs.)

Heterocyclic Compounds-II (Continued Unit II):

Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole,Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline andisoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, Doebner-Miller synthesis, Bischler-Napieralski reaction, Pictet-Spengler reaction, Pomeranz-FritschreactionDerivatives of furan: Furfural and furoic acid.

UnitIV **(12 Hrs.)**

Alkaloids:

Natural occurrence, General structural features, Isolation and their physiological actionHoffmann's exhaustive methylation, Emde's modification, Structure elucidation andsynthesis of Hygrine and Nicotine. Medicinal importance of Nicotine, Hygrine, Quinine,Morphine, Cocaine, and Reserpine.

Terpenes:

Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral,Neral and α-terpineol.

Reference Books:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (PearsonEducation).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Acheson, R.M. *Introduction to the Chemistry of Heterocyclic compounds*, John Welly & Sons, 1976.
5. Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.

6. McMurry, J.E. *Fundamentals of Organic Chemistry*, *7th Ed*. Cengage Learning India Edition, 2013.
7. Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
8. Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press
9. Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Parakashan,2010.

INORGANIC CHEMISTRY-II LAB

SUBJECTCODE-BCHMS1-403 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives:

1. To learn the principles applicable to various experiments.

2. To understand the concepts behind Iodo/Iodimetric titrations
3. To synthesize various inorganic compounds

Course Outcomes:

After completion of course students will gain the knowledge of:

1. Obtaining precise results of Iodo/Iodimetric titrations
2. Preparation of transition metal based inorganic compounds

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included

(A) Iodo/Iodimetric Titrations:

(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution(Iodimetrically).
(ii)Estimation of antimony in tartar-emetic iodimetrically
(iii) Estimation of available chlorine in bleaching powder iodometrically.
(iv) Calculation of percentage dehydration in copper sulphate crystals.
(v) Determination of percentage composition of mixture (copper sulphate and potassium sulphate).

(B) Inorganic preparations:

(i) Preparation of Cuprous Chloride, Cu_2Cl_2
(ii) Preparation of tristhioureacopper(I)chloride
(iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum)
(iv) Preparation of Chrome alum $KCrS_2O_8$
(v) Cis-Trans diaquodioxalatochromate(II)

Reference Books:

1. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.*, Pearson, 2009

ORGANIC CHEMISTRY-III LAB

SUBJECTCODE-BCHMS1-404 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives:

1. To understand the concepts behind detection of extra elements
2. To acquire knowledge of chemistry behind functional group tests
3. To study the quantitative analysis of organic compounds

Course Outcomes:

After completion of course students will acquire the knowledge of:

1. Detection techniques of extra elements
2. Concepts of functional groups detection
3. Quantitative analysis of organic molecules

Note:

1. Students will have to perform atleast 10-12 experiments from the given syllabus.
2. Any other subject related experiment can also be included

Experiments

1. Detection of extra elements
2. Functional group tests for (a) nitro groups
   (b) amine groups
   (c) amide groups
3. Qualitative analysis of unknown organic compounds containing simple functionalGroups:
   (a) Alcohols
   (b) Carboxylic acids
   (c) Phenols
   (d) Other carbonyl compounds

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education, 2009.
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.*,Pearson,2012.
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis*, University Press, 2000.
4. Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry:Qualitative Analysis*, University Press, 2000.

FUEL CHEMISTRY

SUBJECTCODE- BCHMD1-411 **L T PC** **(30 Hrs.)**
2 0 0 2

Course Objectives

1. To study the classification of fuels, uses and their calorific value
2. To understand the industrial uses of petroleum
3. To study the classification and properties of lubricants

Course Outcomes:

After completion of course students will attain the knowledge of:

1. Industrial applications of coal
2. Industrial uses and applications of petroleum
3. Properties and uses of lubricants

UnitI **(8 Hrs.)**

Review of energy sources (renewable and non-renewable). Classification of fuels and theircalorific value.

Coal:

Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization ofcoal. Coal gas, producer gas and water gas-composition and uses. Fractionation of coal tar,uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification(Hydro gasification and Catalytic gasification), Coal liquefaction and solvent refining.

UnitII **(7 Hrs.)**

Petroleum and Petrochemical Industry*:*

Composition of crude petroleum, Refining anddifferent types of petroleum products and their applications.Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking).

UnitIII **(8** Hrs.**)**

Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derivedfrom biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels.Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and itsderivatives Xylene.

UnitIV **(7 Hrs.)**

Lubricants:

Classification of lubricants, lubricating oils (conducting and non-conducting)Solid and semisolid lubricants, synthetic lubricants.Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Reference Books:

1. Stocchi, E. *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK, 1990.
2. Jain, P.C. & Jain, M. *Engineering Chemistry* Dhanpat Rai & Sons, Delhi
3. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut, 1996.

PHARMACEUTICAL CHEMISTRY

SUBJECTCODE-BCHMD1-412 **L T PC** **(30 Hrs.)**
2 0 0 2

Course Objectives

1. To understand the concepts of drug design and development
2. To acquire the knowledge of synthesis of drug molecules.
3. To study the concepts of aerobic and anaerobic fermentation for industrial applications

Course Outcomes:

After completion of course students will gain the knowledge of:

1. Synthetic methods used for the drug design and development
2. Aerobic and anaerobic fermentation and its importance in pharmaceutical industries.

UNIT I (8 Hrs.)

Drugs & Pharmaceuticals-I:

Drug discovery, design and development; Basic Retrosynthetic approach. Synthesis of therepresentative drugs of the following classes: analgesic agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol).

UNIT II (8 Hrs.)

Drugs & Pharmaceuticals-II:

Synthesis of the representative drugs:Antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide,Trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital,Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS relateddrugs (AZT-Zidovudine).

UnitIII (8 Hrs.)

Fermentation-I:

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii)Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin.

UnitIV (6 Hrs.)

Fermentation-II (Continued Unit III):

(iii) Lysine,Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

Reference Books:

1. Patrick, G. L. *Introduction to Medicinal Chemistry, Oxford University* Press, UK, 2013.
2. Singh, H. & Kapoor, V.K. *Medicinal and Pharmaceutical Chemistry*, Vallabh Prakashan, Pitampura, New Delhi, 2012.
3. Foye, W.O., Lemke, T.L. & William, D.A.: *Principles of Medicinal Chemistry*, 4th *Ed*., B.I. Waverly Pvt. Ltd. New Delhi

WAVES AND OPTICS

Subject Code: BPHYS1-202 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objective:
To understand the fundamentals of harmonic oscillations, wave motion,
To provide the knowledge of wave optics: diffraction, interferometer and holography.

Course Outcomes:
- Understanding the concepts of harmonic oscillations, wave motion, wave optics, interference and diffraction.
- Skill enhancement to solve numerical problems related with Waves and Optics.
- Apply knowledge of Waves and Optics to go for higher studies in diverse fields.
- To inculcate and develop the ability to think abstractly.

UNIT-I (15 Hours)

Harmonic oscillations and Superpositions
Introduction to Harmonic oscillations, Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses.

UNIT-II (15 Hours)

Wave Motion

Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

UNIT-III (15 Hours)

Wave Optics and Interference

Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. 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). Newton's Rings: Measurement of wavelength and refractive index. Interferometer: Michelson Interferometer-(1) Idea of form of fringes (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

UNIT-IV (15 Hours)

Diffraction

Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone

Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Reference Books

1 Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2 Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3 Optics, Ajoy Ghatak, 2008, Tata McGraw Hill.
4 The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
5 The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
6 Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

OBJECT ORIENTED PROGRAMMING LANGUAGE IN C++

Subject Code: BMCAS1-204 **L T P C** **(60 Hrs.)**
3 1 0 4

Course Objectives:

1. To develop a greater understanding of the issues involved in programming language design and object oriented paradigms and its implementation.
2. To impart adequate knowledge on the need of object oriented programming languages.
3. To enhance problem solving and programming skills in C++ by implementing the object oriented concepts.
4. To understand the difference between the top-down and bottom-up approach.

Course Objectives:After completion of this course students will be able to:

1. Apply the concepts of object-oriented programming.
2. Illustrate the process of data file manipulations using C++.
3. Apply virtual and pure virtual function and complex programming situations.
4. Describe the object-oriented programming approach in connection with C++.

UNIT-I (14 Hrs.)

Characteristics of Object Oriented Programming: Abstraction, Encapsulation, Data hiding, Inheritance, Polymorphism, Code Extensibility and Reusability, User defined Data Types.Introduction to C++: Identifier, Keywords, Constants, And Operators: Arithmetic, relational, logical, And conditional and assignment. Size of operator, Operator precedence and associativity.

UNIT-II (15 Hrs.)

Classes and Objects: Class Declaration and Class Definition, defining member functions, making functions inline, nesting of member functions, Members access control. this pointer.Objects: Object as function arguments, array of objects, functions returning objects, Const member functions.
Destructors: Properties, Virtual destructors. Destroying objects. Rules for constructors and destructors. Array of objects. Dynamic memory allocation using new and delete operators, Nested and container classes.

UNIT-III (17 Hrs.)

Static data members and Static member functions. Friend functions and Friend classes.
Constructors: properties, types of constructors (Default, parameterized and copy), Dynamic constructors, multiple constructors in classes.
Inheritance: Defining derived classes,inheriting private members,single inheritance,types of derivation, function redefining, constructors in derived class.
Types of Inheritance: Single, Multiple, Multilevel and Hybrid. Types of base classes: Direct, Indirect, Virtual, Abstract. Code Reusability.

UNIT-IV (14 Hrs.)

Polymorphism: Methods of achieving polymorphic behavior.
Operator overloading: overloading binary operator, overloading unary operators, rules for operator overloading, operator overloading using friend function.
Function overloading: Early binding, Polymorphism with pointers, virtual functions,late binding, pure virtual functions and abstract base class. Introduction to File Handling.

Recommended Books:
1. E. Balagurusamy, 'Object Oriented Programming with C++', Tata McGrawHill, **2008**.
2. Deitel and Deitel, 'C++ How to Program', PearsonEducation, **2012**.
3. Herbert Schildt, 'The Complete Reference C++', Tata McGrawHill, **2003**.
4. Robert Lafore, 'Object Oriented Programming in C++', GalgotiaPublications, **2002**.
5. BjarneStrautrup, 'The C++ Programming Language', Addition-Wesley PublicationCo, **1986**.
6. Stanley B. Lippman, JoseeLajoie, 'C++ Primer', Pearson Education, **2002.**

MATHEMATICS-IV

Subject Code: BMATH5-401 **L T P C** **(60 Hrs.)**
3 1 0 4

Course Objective:

To learn about basics and properties of fourier series

To learn about Laplace transformation, inverse Laplace transformation and their uses to solve differential equations

UNIT-I **(14 Hrs.)**

Fourier series: Definition of Periodic functions, Euler's formula, Even and odd functions, half range expansions, Fourier series of different wave forms.

UNIT-II **(16 Hrs.)**

Fourier transform: Dirichlet's conditions, Fourier integral formula, properties of Fourier transform, inversion formula, convolution, Parseval's equality; Fourier transform of generalized functions, application of transforms to heat wave and Laplace equation.

UNIT-III **(15 Hrs.)**

Laplace Transforms: Laplace transforms of functions and its properties, inverse Laplace transforms, transform of derivatives and integrals.

UNIT-IV **(15 Hrs.)**

Laplace transform of unit step function, impulse function, periodic functions, applications to solution of ordinary linear differential equations with constant coefficients and simultaneous differential equations.

Course Outcome: After the completion of the course ,Students will understand :
1. Basics of periodic functions and Fourier series representation.
2. The use of Fourier transforms and its applications in different fields.
3. Laplace and Inverse Laplace transform and their properties.
4. Methods for Laplace transformation and its applications for the solutions of Differential Equations.

References Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. B.S. Grewal, 'Higher Engineering Mathematics', 36th Edn., Khanna Publishers, 2010.

3. Ian N. Sneedon, Elements of Partial Differential Equations, McGraw- Hill, Singapore, 1957.
4. Advanced Engineering Mathematics, O'Neil, Cengage Learning.
5. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
6. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.

WAVES AND OPTICS-LAB

Subject Code: BPHYS1-205 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Note:
1. Maximum 20% experiments could be performed virtually.
2. Any other subject related experiment can also be included.

Course Objective:

1. To learn practically the various concepts of waves and optics.
2. The course will provide hand on training to the students for handling various related instruments.

Course Outcome:

- Able to verify the concepts/laws of Waves and Optics
- To inculcate and develop scientific aptitude by performing the various experiments.
- Skill enhancement by solving experimental problems.
- To inculcate the spirit of teamwork.

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster`s focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes roduced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.
13. To Simulation of interference fringes with different shapes using Fortran Programming
14. To Simulate the effect of coherence on interference fringes
15. To Simulate propagation of EM waves in free space and in an optical fiber

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

SOFTWARE LAB-IV (BASED ON BMCAS1-204)

Subject Code: BMCAS1--207 **L T PC**
0 0 2 1 **(30 Hrs.)**

This laboratory course will comprise as exercises to supplement what is learnt under paper BMCAS1-: 204 Object oriented Programming Usng C++.Students will be provided with Operational Knowledge and Implementation of numerical methods & statistical Techniques using C++ Language

INORGANIC CHEMISTRY-III

SUBJECT CODE -BCHMS1-501 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objectives
1. To understand the concepts behind the basics of coordination chemistry.
2. To understand the concept of chemistry of various transition elements.
3. To familiarize with the chemistry of lanthanoids and actinoids.
4. To introduce the fundamentals of bioinorganic chemistry.

Course Outcomes: After completion of this course, students will be able to:
1. Understand the fundamental concepts of Inorganic and Bioinorganic Chemistry.
2. know the application of Inorganic and Bioinorganic chemistry.
3. Interpret and analyze the facts on the basis of fundamentals of Inorganic and Bioinorganic Chemistry.
4. Differentiate the related concepts of Inorganic chemistry.

Unit I **(15 Hrs.)**

Coordination Chemistry-I:
Werner's theory, valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory, measurement of 10 Dq (Δo), CFSE in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq (Δo, Δt). Octahedral vs. tetrahedral coordination,

Unit II **(15 Hrs.)**

Coordination Chemistry-II:
Tetragonal distortions from octahedral geometry, Jahn-Teller theorem, square planar geometry.Qualitative aspect of Ligand field and MO Theory. IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Chelate effect, polynuclear complexes, Labile and inert complexes.

Unit III **(15 Hrs.)**

Transition Elements:
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer &Bsworth diagrams). Difference between the first, second and third transition series. Chemistry of Ti, V, Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy)

Unit IV **(15 Hrs.)**

Lanthanoids and Actinoids: Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).
Bioinorganic Chemistry: Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine. Iron and its application in bio-systems, Haemoglobin; Storage and transfer of iron.

Reference Books:
1. Purcell, K.F &Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977. • Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.
2. Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.
3. Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry. Wiley-VCH, 1999
4. Basolo, F, and Pearson, R.C., Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.
5. Greenwood, N.N. & Earnshaw A., Chemistry of the Elements, ButterworthHeinemann,1997.

ORGANIC CHEMISTRY-IV

SUBJECT CODE –BCHMS1-502 **L T P C** **(60 Hrs.)**

4 0 0 4

Course Objectives

1. To familiarize the students with the basic concepts of nucleic acids.
2. To elaborate the concept of amino acids, peptides and proteins.
3. To understand the enzymes chemistry and their mechanism of action.
4. To understand the concept of energy in bio systems.

Course Outcomes: The completion of this course will make students to :

1. Understand the basic concepts of nucleic acids, amino acids, peptides and proteins
2. Classify and sketch the synthesis routes of nucleic acids, amino acids, peptides and proteins
3. Analyze enzymes chemistry and their mechanism of action

Outline the energy conversion pathways of bio systems

<u>Unit I</u> **(15 Hrs.)**

Nucleic Acids:

Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and representative reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine. Structure of polynucleotides.

Lipids: Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenation of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity.

<u>Unit II</u> **(15 Hrs.)**

Amino Acids, Peptides and Proteins:

Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, pKa values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting and C-protecting groups -Solid-phase synthesis.

<u>Unit III</u> **(15 Hrs.)**

Enzymes:

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

<u>Unit IV</u> **(15 Hrs.)**

Concept of Energy in Biosystems:

How cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism).

ATP: ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD^+ , FAD.

Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein.Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types

Pharmaceutical Compounds: Structure and Importance

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis),Analgesics: Ibuprofen (with synthesis), Antimalarials : Chloroquine (with synthesis). Medicinal values of curcumin (haldi),

azadirachtin (neem), vitamin C and antacid (ranitidine).

Reference Books:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2006) Biochemistry. VIth Edition. W.H. Freeman and Co.
2. Nelson, D.L., Cox, M.M. and Lehninger, A.L. (2009) Principles of Biochemistry. IV Edition. W.H. Freeman and Co.

3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009) Harper's Illustrated Biochemistry. XXVIII edition. Lange Medical Books/ McGraw-Hill. 32 CHEMISTRY PRACTICAL-C XI

PHYSICAL CHEMISTRY-IV

SUBJECT CODE-BCHMS1-503 **L T P C** **(60 Hrs.)**
4 0 0 4

Course Objectives

1. To familiarize with the concept of conductance and related theories.
2. To introduce basic concepts of electrochemistry.
3. To explain the applications of EMF measurements.
4. To introduce electrical & magnetic properties of atoms and molecules.

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

1. Apply the theories of conductance in various solutions.
2. Understand the role of EMF in determination of physical parameters like pH, entropy etc.
3. Calculate the various physical parameters based on conductance.
4. Predict the electrical & magnetic properties of atoms and molecules.

Unit I **(15 Hrs.)**

Conductance:

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity atinfinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation, Wien effect, Debye-Falkenhagen effect, Walden's rules. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods.

Unit II **(15 Hrs.)**

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts and (iv) hydrolysis constants of salts.

Electrochemistry-I:

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation.

Unit III **(15 Hrs.)**

Electrochemistry-II:

Standard electrode (reduction) potential and its application to different kinds of half-cells.
Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone and glass electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation).

Unit IV **(15 Hrs.)**

Electrical & Magnetic Properties of Atoms and Molecules:

Basic ideas of electrostatics, Electrostatics of dielectric media, Clausius-Mosotti equation, Lorenz-Laurentz equation, Dipole moment and molecular polarizabilities and their measurements. Diamagnetism, paramagnetism, magnetic susceptibility and its measurement.

Reference Books:

1. Atkins, P.W & Paula, J.D. Physical Chemistry, 9th Ed., Oxford University Press (2011).
2. Castellan, G. W. Physical Chemistry 4th Ed., Narosa (2004).
3. Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
4. Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi (2006).
5. Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).

6. Rogers, D. W. Concise Physical Chemistry Wiley (2010).
7. Silbey, R. J.; Alberty, R. A. &Bawendi, M. G. Physical Chemistry 4th Ed., John Wiley & Sons, Inc. (2005).

INORGANIC CHEMISTRY –III LAB

Subject Code: BCHMS1-504 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To develop basic understanding of gravimetric analysis and estimation of different metals using the concept.
2. To familiarize the students with inorganic preparation.
3. To make the students understand principles involved in chromatographic separations.

Course Outcomes: After the completion of this course, students will be able to:

1. Understand the fundamental concepts related to Gravimetric analysis, Inorganic complexes and chromatography.
2. Extend and associate the fundamental concepts to Gravimetric analysis, Inorganic complexes and chromatographic separation .
3. Perform the gravimetric & chromatographic analysis and prepare the Inorganic complexes in the laboratory.

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

Gravimetric Analysis:

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN
iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
iv. Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium oxinate).

Inorganic Preparations:

i. Tetraamminecopper (II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
ii. Iron acetylacetonate
iii. Tetraamminecarbonatocobalt (III) ion
iv. Potassium tris(oxalate)ferrate(III)

Chromatography of metal ions:

i. Principles involved in chromatographic separations.
ii. Paper chromatographic separation of following metal ions:
  i. Ni (II) and Co (II)
  ii. Fe (III) and Al (III)

Reference Book:

1. Vogel, A.I. A text book of Quantitative Analysis, ELBS 1986.

ORGANIC CHEMISTRY –IV LAB

Subject Code: BCHMS1-505 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To develop basic understanding of estimation of amino acids and proteins
2. To study the action of salivary amylase and the effect of various parameters on its action.
3. To determine various physical parameters of oil and fat.
4. To make them familiar with the procedures for synthesis of drugs and peptides

Course Outcomes: The completion of this course will make students able to:

1. Estimate amino acids, proteins and other natural products by chemical methods
2. Study the action of salivary amylase and the effect of various parameters on its action.
3. Calculate the physical parameters of oil and fat.
4. Learn the procedures for synthesis of drugs and peptides and apply the methods to synthesize basic drug molecules

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

1. Estimation of glycine by Sorenson's formalin method.
2. Study of the titration curve of glycine.
3. Estimation of proteins by Lowry's method.
4. Study of the action of salivary amylase on starch at optimum conditions.
5. Effect of temperature on the action of salivary amylase.
6. Saponification value of oil or a fat.
7. Determination of Iodine number of an oil/ fat.
8. Isolation and characterization of DNA from onion/ cauliflower/peas.
9. Synthesis of drugs: Paracetamol, Ibuprofen, Chloroquine, acetaminophen and Aspirin
10. Determination of pK_a and isoelectric points of amino acids:Alanine, Cystine, Glutamic acid and Histidine
11. Synthesis of peptides using N-protecting, C-protecting groups and DCC.

Reference Books:

1. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
2. Arthur, I. V. Quantitative Organic Analysis, Pearson.

PHYSICAL CHEMISTRY –IV LAB

Subject Code: BCHMS1-506 **L T P C** **(60 Hrs.)**
0 0 4 2

Course Objectives

1. To familiarise with the working of the conductivity meter.
2. To familiarise with determination of cell constant.
3. To introduce the principle of conductometric titrations.
4. To introduce the principle of potentiometric titrations.

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

1. Standardise the conductivity meter.
2. Handle various electrodes.
3. Apply conductometric titrations for various determinations.
4. Perform potentiometric titrations for various applications.

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

Conductometry:

i. Determination of cell constant

ii. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

iii. Perform the following conductometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base
- iii. Mixture of strong acid and weak acid vs. strong base
- iv. Strong acid vs. weak base

Potentiometry:

i. Perform the following potentiometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base
- iii. Dibasic acid vs. strong base
- iv. Potassium dichromate vs. Mohr's salt

Reference Books:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

APPLICATIONS OF COMPUTERS IN CHEMISTRY

Subject Code: BCHMD1-511 **L T P C** **(45 Hrs.)**
3 0 0 3

Course Objectives
1. To familiarize with the basics of computers.
2. To understand the roots of equations and differential calculus.
3. To understand basic concepts of simultaneous equations and molecular modelling

Course Outcomes: The completion of this course students will be able to:
1. Understand the basic concepts of computers
2. Solve the numerical problems based on concepts of roots of equations, differential calculus and simultaneous equations
3. Learn basic concepts of molecular modelling

Unit I **(11 Hrs.)**

Basics:
Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics.
Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Matrix addition and multiplication. Statistical analysis

Unit II **(11 Hrs.)**
Numerical methods:
Roots of equations:
Numerical methods for roots of equations:Quadratic formula, iterative method, Newton-Raphson method, Binary bisection and Regula-Falsi.
Differential calculus: Numerical differentiation.

Unit III **(11 Hrs.)**
Integral calculus:
Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values. Simultaneous equations:
Matrix manipulation: addition, multiplication. Gauss-Siedal method.

Unit IV **(12 Hrs.)**
Interpolation, extrapolation and curve fitting:
Handling of experimental data.
Conceptual background of molecular modelling:
Potential energy surfaces. Elementary ideas of molecular mechanics and practical MO methods.

Reference Books:
1. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
2. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.
3. Noggle, J. H. Physical chemistry on a Microcomputer. Little Brown & Co. (1985).
4. Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996

INSTRUMENTAL METHODS OF ANALYSIS

Subject Code: BCHMD1-512 **L T P C** **(45 Hrs.)**
30 0 3

Course Objectives

1. To familiarize with qualitative and quantitative aspects of analysis.
2. To introduce optical methods of analysis.
3. To explain the concepts of thermal methods and electroanalytical methods.
4. To introduce the concept of separation techniques.

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

1. Apply qualitative and quantitative analysis for appropriate purposes.
2. Carry out analytical estimations scientifically using appropriate methods.
3. Understand the principle and instrumentation of various instruments used for analytical purpose.
4. Select and apply suitable separation techniques for separation in mixtures.

Unit I **(11 Hrs.)**

Qualitative and quantitative aspects of analysis:
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution, if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Optical methods of analysis:
Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law.
UV-Visible Spectrometry:
Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument;

Unit II **(12 Hrs.)**

Basic principles of quantitative analysis:
Estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.
Infrared Spectrometry:
Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Unit III **(12 Hrs.)**

Thermal methods of analysis:
Theory of thermogravimetry (TG), basic principle of instrumentation. Techniques for quantitative estimation of Ca and Mg from their mixture.
Electroanalytical methods:Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

Unit IV **(10 Hrs.)**

Separation techniques:

Solvent extraction: Classification, principle and efficiency of the technique.
Mechanism of extraction: extraction by solvation and chelation.
Technique of extraction: batch, continuous and counter current extractions.
Chromatography: Classification, principle and efficiency of the technique.
Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods.
Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic techniques using chiral columns (GC and HPLC).

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London.
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

NOVEL INORGANIC SOLIDS

Subject Code: BCHMD1-513 **L T P C** **(45 Hrs.)**
30 0 3

Course Objectives
1. To familiarize with synthesis and modification of inorganic solids.
2. To understand the concept of nanomaterials.
3. To understand engineering materials for mechanical construction.
4. To understand composite materials and polymers

Course Outcomes: The completion of this course will make students to acquire the knowledge of:
1. Basic concepts of synthesis and modification of inorganic solids
2. Concepts of nanomaterials
3. Basic concepts engineering materials for mechanical construction
4. Fundamentals of composite materials and polymers

Unit I **(12 Hrs.)**

Synthesis and modification of inorganic solids:
Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods.
Inorganic solids of technological importance:
Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments.

Unit II **(11 Hrs.)**

Nanomaterials:
Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires.

Unit III **(10 Hrs.)**

Introduction to engineering materials for mechanical construction:
Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes

Unit IV **(12 Hrs.)**

Composite materials:
Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.
Speciality polymers:
Conducting polymers - Introduction, conduction mechanism, polyacetylene and polypyrole, applications of conducting polymers

Reference Books:
1. Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)
2. Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry.
3. Frank J. Ovens, Introduction to Nanotechnology

APPLICATIONS OF COMPUTERS IN CHEMISTRY LAB

Subject Code:BCHMD1-514 **L T P C** **(30 Hrs.)**
0 0 2 1

Course Objectives

1. To make the students develop programs to solve chemistry problems using computer programs based on numerical methods.
2. To understand the basic tools of computer science in relation with chemistry.
3. To differentiate between systematic errors and random errors and how to delete or reduce their effects.
4. To design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

Course Outcomes: The completion of this course will make student able to:

1. Understand the basic tools of computer science in relation with chemistry.
2. Develop programs to solve chemistry problems using computer programs based on numerical methods.
3. Differentiate between systematic errors and random errors and how to delete or reduce their effects.
4. Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

EXPERIMENTS

Computer programs based on numerical methods for:

1. Roots of equations: (e.g. volume of Van der Waals gas and comparison with ideal gas, pH of a weak acid).
2. Numerical differentiation (e.g., change in pressure for small change in volume of a Van der Waals gas, potentiometric titrations).
3. Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values.
4. Matrix operations. Application of Gauss-Siedel method in colourimetry.
5. Simple exercises using molecular visualization software.

Reference Books:

1. McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008).
2. Mortimer, R. Mathematics for Physical Chemistry. 3rd Ed. Elsevier (2005).
3. Steiner, E. The Chemical Maths Book Oxford University Press (1996).
4. Yates, P. Chemical Calculations. 2nd Ed. CRC Press (2007).
5. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
6. Levie, R. de, How to use Excel in analytical chemistry and in general scientific data analysis, Cambridge Univ. Press (2001) 487 pages.
7. Noggle, J. H. Physical Chemistry on a Microcomputer. Little Brown & Co. (1985).
8. Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).

INSTRUMENTAL METHODS OF ANALYSIS LAB

Subject Code:BCHMD1-515 **L T P C** **(30 Hrs.)**
0 0 21

Course Objectives

1. To familiarize with preparation of TLC.
2. To familiarize with chromatographic separation of mixtures.
3. To introduce the basic concept of extractions techniques.
4. To familiarise with working of UV/VIS spectrophotometer.

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

1. Prepare and use TLC
2. Perform chromatographic separations.
3. Apply the concept of solvent extraction.
4. Apply spectrophotometric determination of various quantities.

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

Separation Techniques
Chromatography: Separation of mixtures

i. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}.
ii. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
iii. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
iv. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

Solvent Extractions:

i. To separate a mixture of Ni^{2+}& Fe^{2+} by complexation with DMG and extracting the Ni^{2+}- DMG complex in chloroform, and determine its concentration by spectrophotometry.
ii. Solvent extraction of zirconium with amberliti LA-1, separation from a mixture of irons and gallium.
iii. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
iv. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.
v. Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate
vi. Ion exchange: (i) Determination of exchange capacity of cation exchange resins and anion exchange resins. (ii) Separation of metal ions from their binary mixture. (iii) Separation of amino acids from organic acids by ion exchange chromatography.

Spectrophotometry:

i. Determination of pKa values of indicator using spectrophotometry.
ii. Structural characterization of compounds by infrared spectroscopy.
iii. Determination of dissolved oxygen in water.
iv. Determination of chemical oxygen demand (COD).
v. Determination of Biological oxygen demand (BOD).
vi. Determine the composition of the Ferric-salicylate/ ferric-thiocyanate complex by Job's method.

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed. The English Language Book Society of Longman .
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. &Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods, Elles Harwood Ltd. London. 45
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

NOVEL INORGANIC SOLIDS LAB

Subject Code: BCHMD1-516 **L T P C** **(30 Hrs.)**
0 0 2 1

Course Objectives

1. To familiarize with determination of cation exchange method and total difference of solids
2. To understand the basic concept of synthesis of hydrogels and nanoparticals

Course Outcomes: The completion of this course will make students will be:

1. Able to understand basic concepts of determination of cation exchange method and total difference of solids
2. Familiarize with basic concept of synthesis of hydrogels and nanoparticals

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

EXPERIMENTS

1. Determination of cation exchange capacity.
2. Determination of total difference of solids.
3. Synthesis of hydrogel by co-precipitation method.
4. Synthesis of Iron, Zinc and copper metal nanoparticles by any two methods.
5. Estimation of Aluminium in various alloys.
6. Estimation of copper in various alloys.
7. Synthesis of any two nanocomposites.

Reference Book:

1. Fahan, Materials Chemistry, Springer (2004).

PHYSICAL CHEMISTRY V

Subject Code: BCHMS1-601 **L T P C** **Duration: 60 Hrs.**
4 0 0 4

Course Objectives

1. To understand the concept of quantum mechanics, Schrödinger wave equation and its applications
2. To introduce the concept of spherical harmonics and quantum chemical description of chemical bonding
3. To familiarize with the basics of electronic, vibrational and nuclear magnetic resonance spectroscopy
4. To understand fundamentals of photochemistry including photochemical reactions in biochemical processes

Course Outcomes:

The students will be able to:

1. Understand the concept of quantum mechanics, molecular spectroscopy and photochemistry
2. Solve numerical problems based on the concept of quantum mechanics.
3. Analyze the spectroscopic transition.
4. Quantitative analysis of photochemical reactions

UNIT I (15 Hrs.)

Quantum Chemistry:

Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.

Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component.

UNIT II (15 Hrs.)

Rigid rotator model of rotation of diatomic molecule. Schrödinger equation, transformation to spherical polar coordinates. Separation of variables. Spherical harmonics. Discussion of solution. Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorm and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).

Chemical bonding: Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of H_2^+. Bonding and antibonding orbitals. Qualitative extension to H_2. Comparison of LCAO-MO and VB treatments of H_2 (only wavefunctions, detailed solution not required) and their limitations.

UNIT III (16 Hrs.)

Molecular Spectroscopy:

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-

rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.
Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.
Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.
Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.

UNIT IV **(14 Hrs.)**

Photochemistry:
Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.

Reference Books:
1 Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2 Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill (2001).
3 House, J. E. Fundamentals of Quantum Chemistry 2nd Ed. Elsevier: USA (2004).
4 Lowe, J. P. & Peterson, K. Quantum Chemistry, Academic Press (2005).
5 Kakkar, R. Atomic & Molecular Spectroscopy, Cambridge University Press (2015).

INORGANIC CHEMISTRY-IV

Subject Code: BCHMS1-602 | **L T P C 4 0 0 4** | **Duration: 60 Hrs.**

Course Objectives

1. To understand the basic principles involved in analysis of cations and anions
2. To familiarize with organometallic compounds, 18 electron rule, metal carbonyls and metal alkyls
3. To introduce inorganic reaction mechanisms, trans effect
4. To understand the concept of catalysis by organometallic compounds

Course Outcomes:

The students will be able to

1 Understand solubility products, common ion effect. group reagents and interfering anions
2 Familiarize with organometallic compounds, p acceptor ligands and metal alkyls 3
Understand the mechanism of substitution in square planar and octahedral complexes
4 Write mechanism of various catalytic processes including hydrogenation, Hydroformylation
5 Get knowledge of preparation methods and reactions of ferrocene

UNIT I **(13 Hrs.)**

Theoretical Principles in Qualitative Analysis (H_2S Scheme):
Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II.

UNIT II **(18 Hrs.)**

Organometallic Compounds:
Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

UNIT III **(12 Hrs.)**

Reaction Kinetics and Mechanism:
Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects and reaction rates, Mechanism of substitution in octahedral complexes.

UNIT IV **(17 Hrs.)**

Catalysis by Organometallic Compounds:

Study of the following industrial processes and their mechanism: Alkene hydrogenation (Wilkinsons Catalyst), Hydroformylation (Co salts), Wacker Process, Synthetic gasoline (Fischer Tropsch reaction), Synthesis gas by metal carbonyl complexes

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

Reference Books:

1 Vogel, A.I. *Qualitative Inorganic Analysis*, Longman, 1972 36

2 Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall,1996-03- 07.

3 Cotton, F.A. G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.;*Wiley India,

4 Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.

5 Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005

6 Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry3rd Ed.*, John Wiley and Sons, NY, 1994.

7 Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements, Elsevier 2nd Ed*, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).

8 Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.

9 Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.

10 Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.

11 Basolo, F. & Person, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.

12 Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977

13 Miessler, G. L. & Donald, A. Tarr, *Inorganic Chemistry 4th Ed.*, Pearson, 2010.

14 Collman, James P. et al. *Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.

15 Crabtree, Robert H. *The Organometallic Chemistry of the Transition Metals*. *J* New York, NY: John Wiley, 2000.

16 Spessard, Gary O., &Gary L. Miessler. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

ORGANIC CHEMISTRY-V

Subject Code: BCHMS1-603 **L T P C 4 0 0 4** **Duration: 60 Hrs.**

Course Objectives

1. To understand the basic principles of organic spectroscopy including UV, IR and NMR spectroscopy
2 To familiarize with mechanistic pathways of complex organic molecules
3. To familiarize with classification/biological significance/color/constitution of carbohydrates/dyes
4. To understand concepts of classification/chemistry of polymers and fabrics

Course Outcomes:

After completion of the course, students will be able to:

1. Achieve the fundamentals of UV/IR/NMR spectroscopy for organic molecules
2. Write mechanisms of various organic molecules (simple/complex molecules)
3. Explain concepts behind classification/biological significance/color/constitution of carbohydrates/dyes
4. Describe concepts of classification/chemistry of polymers and fabrics

UNIT I (18 Hrs.)

Organic Spectroscopy: General principles Introduction to absorption and emission spectroscopy.
UV Spectroscopy: Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.
NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpetation of NMR spectra of simple compounds.

UNIT II (16 Hrs.)

Carbohydrates: Occurrence, classification and their biological importance.
Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Inter conversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides – Structure elucidation of maltose, lactose and sucrose.
Polysaccharides: Elementary treatment of starch, cellulose and glycogen.

UNIT III (13 Hrs.)

Dyes: Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.

UNIT IV **(13 Hrs.)**

Polymers: Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index.

Polymerisation reactions:Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);

Fabrics: Natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

Reference Books:

1 Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
2 Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3 Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
4 Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
5 Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
6 Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
7 Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, OxfordUniversity Press.
8 Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Prakashan(2010).
9 Kemp, W. *Organic Spectroscopy*, Palgrave

PHYSICAL CHEMISTRY LAB-V

Subject Code: BCHMS1-604 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Course Objective:

1. To acquaint the students with the basics absorption spectroscopy
2. To make the students learn to run the UV VIS Spectrophotometer and its various applications in chemical analysis
3. To learn colourimetry techniques for various analytical applications .

Course Outcomes:

The students will be able to:

1. Understand the basics absorption spectroscopy
2. Run the UV VIS Spectrophotometer and do various chemical analysis using the technique
3. Do chemical analysis using colourimetry techniques

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

UV/Visible spectroscopy

I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

I. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration.
II. Determine the concentrations of $KMnO_4$ and $K_2Cr_2O_7$ in a mixture.
III. Study the kinetics of iodination of propanone in acidic medium.
IV. Determine the amount of iron present in a sample using 1,10-phenathroline.
V. Determine the dissociation constant of an indicator (phenolphthalein).
VI. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
VII. Analysis of the given vibration-rotation spectrum of HCl(g)

Reference Books

1 Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry,* R. Chand & Co.: New
2 'Findlay's Practical Physical Chemistry'.
3. J.B. Yadav, 'Advanced Practical Physical Chemistry'.

INORGANIC CHEMISTRY LAB-IV

Subject Code: BCHMS1-605 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Course Objective:

1 To understand qualitative semi micro analysis of mixtures containing 3 anions and 3 cations.

2 To provide knowledge of various methodologies for synthesis of target molecules

Course Outcomes:

The students will acquire knowledge of

1 Analysis of mixture for cations and anions 2 Syntheses of inorganic complexes

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments

1 Qualitative semi micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:
CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+,Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+},Mg^{2+}
Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$,$SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3)**or** combination of anions e.g. $CO_3^{2-}$and SO_3^{2-}, NO_2^- and NO_3^-,Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO_3^- and Br^-, NO_3^- and I^-. Spot tests should be done whenever possible.

2. Measurement of 10 Dq by spectrophotometric method
3. Verification of spectrochemical series.
4. Controlled synthesis of two copper oxalate hydrate complexes: kinetic vs thermodynamic factors.
5. Preparation of acetylacetanato complexes of Cu^{2+}/Fe^{3+}. Find the λmax of the complex.
6. Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Reference Books:

1 Vogel's *Qualitative Inorganic Analysis*, Revised by G. Svehla.
2 Marr & Rockett *Inorganic Preparations.*

ORGANIC CHEMISTRY LAB-V

Subject Code: BCHMS1-606 **L T P C** **Duration: 60 Hrs.**
0 0 4 2

Course Objective:
1 To provide knowledge of extraction of organic compounds from natural sources. 2 To familiarize with syntheses of compounds
3 Analysis of unknown organic molecules
4. To identify organic compounds by applying IR//NMR spectroscopic concepts

Course Outcomes:

After completion of the course, students will be able to:

1. Extract caffeine from tea leaves
2. Carry out selected polymeric reactions/methyl orange
3. Detect various organic functional group
4. Identify organic compounds by applying IR//NMR spectroscopic concepts

<u>Note:</u>
1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments
1. Extraction of caffeine from tea leaves.
2. Preparation of sodium polyacrylate.
3. Preparation of urea formaldehyde.
4. Analysis of Carbohydrate: aldoses and ketoses, reducing and non-reducing sugars.
5. Qualitative analysis of unknown organic compounds containing monofunctional groups (carbohydrates, aryl halides, aromatic hydrocarbons, nitro compounds, amines and amides) and simple bifunctional groups, for e.g. salicylic acid, cinnamic acid, nitrophenols etc.
6. Identification of simple organic compounds by IR spectroscopy and NMR spectroscopy (Spectra to be provided).
7. Preparation of methyl orange.

Reference Books:

1 Vogel, A.I. *Quantitative Organic Analysis*, Part 3, Pearson (2012).
2 Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
3 Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.*, Pearson (2012)
4 Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis*, University Press (2000).
5 Ahluwalia, V.K. & Dhingra, S. *Comprehensive Practical Organic Chemistry: Qualitative Analysis,* University Press (2000).

POLYMER CHEMISTRY

Subject Code: BCHMD1-611 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives

1. To recall concepts involved in polymerization..
2. To introduce various mechanism and kinetics of polymer.
3. To introduce properties and factor affecting the properties of polymers
4. To familiarise with applications of polymer.

Course Outcomes:

The students will be able to

1. concept of polymers and polymer related termnology.
2. To familiarize with concept of kinetics of Polymerization, Morphology of crystalline polymers.
3. Apply the advanced polymer in various field of industries.
4. Analyze the crystal structure of polymer with advanced characterization techniques

UNIT I **(11 Hrs.)**

Introduction and history of polymeric materials: Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.
Functionality and its importance: Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

UNIT II **(11 Hrs.)**

Kinetics of Polymerization: Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.
Crystallization and Crystallinity: Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.
Nature and structure of polymers: Structure Property relationships.

UNIT III **(11 Hrs.)**

Determination of molecular weight of polymers:(*Mn*, *Mw*, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.
Glass transition temperature (Tg) and determination of Tg: Free volume theory, WLF equation, Factors affecting glass transition temperature (Tg).

UNIT IV **(12 Hrs.)**

Polymer Solution: Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.
Properties of Polymers (Physical, Thermal, Flow & Mechanical Properties): Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].

Reference Books:
1 *Seymour's Polymer Chemistry,* Marcel Dekker, Inc.
2 G. Odian: Principles of Polymerization, John Wiley.
3 F.W. Billmeyer: Text Book of Polymer Science, John Wiley.
4 P. Ghosh: Polymer Science & Technology, Tata Mcgraw-Hill.
5 R.W. Lenz: Organic Chemistry of Synthetic High Polymers.

MOLECULAR MODELLING AND DRUG DESIGN

Subject Code: BCHMD1-612 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives

1. To impart knowledge about concept of molecular modelling
2. To understand computer simulation methods
3. To familiarize molecular dynamics and monte carlo simulation methods
4. To understand structure prediction and drug design

Course Outcomes:

The students will be able to:

1. Understand the concept of molecular modelling
2. Learn computer simulation methods
3. Apply molecular dynamics and monte carlo simulation methods on different molecules
4. Predict structure and design new drug molecules

UNIT I **(11 Hrs.)**

Introduction to Molecular Modelling: Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces. Computer Hardware and Software. The Molecular Modelling Literature.

Force Fields: Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics. Force Field Models for the Simulation of Liquid Water.

UNIT II **(11 Hrs.)**

Energy Minimization and Computer Simulation: Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Computer simulation methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.

UNIT III **(11 Hrs.)**

Molecular Dynamics & Monte Carlo Simulation: Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of molecules. Models used in Monte Carlo simulations of polymers.

UNIT IV **(12 Hrs.)**

Structure Prediction and Drug Design: Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.

4 Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics

Reference Books:

1 A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.
2 J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.
3 Satya Prakash Gupta, QSAR and Molecular Modeling, Springer – Anamaya Publishers, 2008.

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Subject Code: BCHMD1-613 **L T P C** **Duration: 45 Hrs.**
3 0 0 3

Course Objectives

1. To impart knowledge about manufacturing and properties of glasses, ceramics and cements
2. To understand manufacturing of different fertilizers and surface coating
3. To develop an understanding about primary and secondary batteries
4. To understand the mechanism of homogeneous catalysis

Course Outcomes:

The students will acquire knowledge of

1. Types, classification and manufacturing process of glass, ceramics and cement
2. Classification of surface coatings paints and pigment formulation
3. Different types of fertilizers and their manufacturing processes
4. Classification of alloys, properties of different types of steel
5. Homogeneous and hetrerogeneous catalyst and their industrial applications

UNIT I (11 Hrs.)

Silicate Industries *Glass:* Glassy state and its properties, classification (silicate and non-silicate glasses).Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.
Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.
Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

UNIT II (11 Hrs.)

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.
Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

UNIT III (12 Hrs.)

Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.
Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

UNIT IV **(11 Hrs.)**

Catalysis: General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts. Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

1 E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2 R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3 W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi.
4 J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5 P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6 R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7 B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

POLYMER CHEMISTRY LAB

Subject Code: BCHMD1-614 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objective:

1. To familiarize with syntheses of different polymers
2. To understand characterization techniques for polymers
3 Analysis of polymers using different instrumental techniques and IR methods

Course Outcomes:

The students will acquire knowledge of
1 Synthesis of different polymers
2 Apply techniques for the determination of Molecular weight.
3. Analyze structure of polymer by instrumental methods such as IR spectrometer.

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

1. **Polymer synthesis**

1.Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA)/ Acrylic acid (AA).
a. Purification of monomer
b.Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutylonitrile (AIBN)
2. Preparation of nylon 66/6
3. Redox polymerization of acrylamide
4. Preparation of urea-formaldehyde resin
5. Preparations of novalac resin/resold resin.

Polymer characterization

1. Determination of molecular weight by viscometry:
(a) Polyacrylamide-aq.$NaNO_2$ solution
(b) Poly vinyl proplylidine (PVP) in water
(c) Polymethyl methacrylate (PMMA)
2. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).

Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
2. Instrumental Techniques
3. IR studies of polymers

Reference Books:

1 Malcohm P. Stevens, Polymer Chemistry: An Introduction, 3rd Ed.
2 Harry R. Allcock, Frederick W. Lampe and James E. Mark, Contemporary Polymer Chemistry, 3rd ed. Prentice-Hall (2003)
3 Fred W. Billmeyer, Textbook of Polymer Science, 3rd ed. Wiley-Interscience (1984)
4 Joel R. Fried, Polymer Science and Technology, 2nd ed. Prentice-Hall (2003)
5 Petr Munk and Tejraj M. Aminabhavi, Introduction to Macromolecular Science, 2nd ed. John Wiley & Sons (2002)
6 L. H. Sperling, Introduction to Physical Polymer Science, 4th ed. John Wiley & Sons (2005)
7 Malcolm P.zq4 Stevens, Polymer Chemistry: An Introduction, 3rd ed. Oxford University Press (2005)
8 Seymour/ Carraher's Polymer Chemistry, 9th ed. by Charles E. Carraher, Jr. (2013).

MOLECULAR MODELLING AND DRUG DESIGN LAB

Subject Code: BCHMD1-615 **L T P C** **0 0 2 1** **Duration: 30 Hrs.**

Course Objective:

1. To draw the chemical structure structure of the molecules using various drawing packages
2. To perform different modelling simulations methods for optimization of bond lengths and bond angles to obtain minimum strain energy structure of the molecule.
3. To run programs to calculate physico chemical properties and spectroscopic of molecules

Course Outcomes:

The students will be able to:

1. Draw the chemical structure structure of the molecules using various drawing packages
2. Perform different molecular modelling simulations for optimization of bond lengths and bond angles to obtain minimum strain energy structure of the molecule.
3. Run programs to calculate physico chemical properties and spectroscopic of molecules

Note:

Note:

1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments

1 Compare the optimized C-C bond lengths in ethane, ethene, ethyne and benzene. Visualize the molecular orbitals of the ethane σ bonds and ethene, ethyne, benzene and pyridine π bonds.

2 (a) Perform a conformational analysis of butane. (b) Determine the enthalpy of isomerization of *cis* and *trans* 2-butene.

3 Visualize the electron density and electrostatic potential maps for LiH, HF, N_2, NO and CO and comment. Relate to the dipole moments. Animate the vibrations of these molecules.

4 (a) Relate the charge on the hydrogen atom in hydrogen halides with their acid character. (b) Compare the basicities of the nitrogen atoms in ammonia, methylamine, dimethylamine and trimethylamine.

5 (a) Compare the shapes of the molecules: 1-butanol, 2-butanol, 2-methyl-1-propanol, and 2-methyl-2-propanol. Note the dipole moment of each molecule. (b) Show how the shapes affect the trend in boiling points: (118 ºC, 100 ºC, 108 ºC, 82 ºC,respectively).

6 Build and minimize organic compounds of your choice containing the following functional groups. Note the dipole moment of each compound: (a) alkyl halide (b) aldehyde (c) ketone (d) amine (e) ether (f) nitrile (g) thiol (h) carboxylic acid (i) ester (j) amide.

7. (a) Determine the heat of hydration of ethylene. (b) Compute the resonance energy of benzene by comparison of its enthalpy of hydrogenation with that of cyclohexene.

8. Arrange 1-hexene, 2-methyl-2-pentene, (*E*)-3-methyl-2-pentene, (*Z*)-3-methyl-2- pentene, and 2,3-dimethyl-2-butene in order of increasing stability.

9 (a) Compare the optimized bond angles H_2O, H_2S, H_2Se. (b) Compare the HAH bond angles for the second row dihydrides and compare with the results from qualitative MO theory.

Note: Software: ChemSketch, ArgusLab (www.planaria-software.com), TINKER 6.2 (dasher.wustl.edu/ffe), WebLab Viewer, Hyperchem, or any similar software.

Reference Books:

1 A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.
2 J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and

Sons, 1997.
3 Satya Prakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE LAB

Subject Code: BCHMD1-616 **L T P C** **Duration: 30 Hrs.**
0 0 2 1

Course Objective:
1. To impart knowledge and hand-on experiences of different analytical techniques for chemical analysis
2. To impart skills for preparation of buffer

Course Outcomes:
The students will acquire knowledge

1. Different analytical techniques for analysis different materials

2. Preparation of buffer solution

Note:
1. Students will have to perform atleast 10-12 experiments from the given list/topic.
2. Any other subject related experiment can also be included.

Experiments
1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Electroless metallic coatings on ceramic and plastic material.
5. Determination of composition of dolomite (by complexometric titration).
6. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
7. Analysis of Cement.
8. Preparation of pigment (zinc oxide).
9 To study the saponification reaction for preparation of soap.
10 Preparation of buffers and measurement of their pH

11 Determination standard electrode potential of Fe^{2+}/Fe^{3+} system by potentiometer using potassium permanganate solution.

Reference Books:

1 E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2 R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
3 W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, Wiley Publishers, New Delhi.
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6 R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
7 B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

File No. I-15/1258/2023-DEAN ACAD-MRSPTU-BTD

Autonomous

Universities of Punjab

MAHARAJA RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY-BATHINDA

O/o DEAN ACADEMIC-MRSPTU-BATHINDA

SUBJECT

Main Category	:	Approvals
Sub Category	:	
Description	:	Regarding proposal for extension in tenure of BoS Agriculture Sciences upto 08.08.2024

OTHER DETAILS

Language	:	English
Remarks	:	

No correspondence is attached in this file.

Note No. #1

In reference to the subject matter, it is to inform that the Board of Studies in Agriculture Sciences which was constituted in the year 2021 was expired on 12.08.2023 (copy attached).

Whereas, the tenure of all other newly constituted Board of Studies which were constituted in 2022 are expiring on 08.08.2024.

Therefore, it is proposed to extend the tenure of BoS in Agriculture Sciences upto 08.08.2024.

Moreover, the newly recruited faculty Dr. Wineet Chawala, Assistant Professor School of Agriculture Engineering & Technology may be added as co-opted member in the same BoS upto 08.08.2024.

This is submitted for your consideration and approval, please.

BOS in Agriculture Sciences.pdf

18/09/2023 12:11 PM

SATNAM SINGH
(ASST. DEAN(ACADEMICS)-MRSPTU)

Note No. #2

Recommended and submitted for your approval, please.

18/09/2023 1:22 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

Note No. #3

Approved.

18/09/2023 1:48 PM

BUTA SINGH SIDHU
(VICE CHANCELLOR-MRSPTU-BTD)

ਮਹਾਰਾਜਾ ਰਣਜੀਤ ਸਿੰਘ ਪੰਜਾਬ ਤਕਨੀਕੀ ਯੂਨੀਵਰਸਿਟੀ, ਬਠਿੰਡਾ
ਡੱਬਵਾਲੀ ਰੋਡ, ਬਠਿੰਡਾ - 151001

Maharaja Ranjit Singh Punjab Technical University
DABWALI ROAD, BATHINDA-151001
[A State University Estb. by Govt. of Punjab Act No. 5(2015) u/s 2(f) & Approved u/s 12B of UGC Act, 1956]

ਡੀਨ (ਅਕਾਦਮਿਕ ਮਾਮਲੇ) DEAN (Academic Affairs)

Ref. No.: DAA/MRSPTU/Notification/ 115 **Date:** 13.08.2021

NOTIFICATION

BOARD OF STUDIES IN AGRICULTURE SCIENCES

(Tenure: 13.08.2021 to 12.08.2023)

Whereas, Maharaja Ranjit Singh Punjab Technical University has been established u/s 2(f) of the UGC Act, 1956; vide Punjab Act 5(2015) notified through Punjab Government Gazette Extraordinary (Regd No CHD/0092/2015-2017) Notification No. 5-Leg./2015 dated 12th February 2015.

Further Whereas, the structure of Board of Studies for various courses running in the University was approved by the Board of Governors of MRSPTU vide item 2.19 in its 2nd meeting held on 7.9.2015.

Whereas, with approval of the competent authority vide no. VC/319 dt. 12.08.2021, BoS in Agriculture Sciences is notified as under:

SNo	NOMENCLATURE	NAME & ADDRESS	DESIGNATION
(i)	Head of the University Department concerned	Dr. Kawaljit Singh Sandhu, Associate Professor, Deptt of Food Sci & Tech, MRSPTU, Bathinda Email: kssandhu@mrsptu.ac.in (Mob. 7015709403)	**CHAIRPERSON** (Ex-Officio)
(ii)	One Faculty member from University Department concerned (of each specialization)	Vacant (This program is going to start in MRSPTU from Sept, 2021 onwards. These shall be included as and when available. At present no faculty is available).	Member(s)
(iii)	One Expert (in the subject from outside the Univ.)	Dr. Jitender Singh Brar Retired Director, PAU, Krishi Vigyan Kendra, Bathinda. Email: jitender62brar@gmail.com (Mob. 9417732932)	Member
(iv)	Two Experts (nominated by the Vice Chancellor)	1. Dr. Sandeep Singh Sandhu Principal Agronomist Climate Change & Agricultural Meterology Punjab Agricultural University, Ludhiana Email: ssandhu@pau.edu (Mob. 8146300110) 2. Dr. K.K. Gill Principal Agrometeorologist Communication Centre, PAU, Ludhiana Email: kkgill@pau.edu (Mob. 9855385287)	Members
(v)	Two Faculty members (from Affiliated/ Constituent colleges)	1. Dr. S. S. Bal Professor & Dean (Deptt. of Agriculture), Baba Farid College, Bathinda Email: drssbal@yahoo.co.in (Mob. 9501115223) 2. Dr. K.S. Dadhich Professor & Director Academics & Research, Dolphin PG College, Chunni Kalan Email: ksd1947@gmail.com (Mob. 8079054475)	Members

Note No. #1 **Attachment:BOS in Agriculture Sciences.pdf**

(vi)	One representative (from industry/ corporate sector)	Jagtar Singh Brar, Progressive Farmer VPO: Mehma Sarja, Bathinda Email: jagtarbrarbti@gmail.com (Mob. 9417158928)	Member
(vii)	One Post-Graduate meritorious alumnus	Vacant (Not available at present)	Member
(viii)	Any other against vacancy of (ii) & (vii) above (for 2 years or untill further orders whichever is earlier)	1. Dr. Amarinder Singh Riar Assistant Professor, Deptt of Agriculture, GNDU, Amritsar, Email: amarinder.agri@gndu.ac.in (Mob. 8146255300) 2. Dr. Gurupkar Singh Sidhu Fruit Biotechnologist, Room no. 204 School of Agricultural Biotechnology, PAU, Ludhiana, Email: gurupkar-soab@pau.edu (Mob. 9781503780)	

For Programmes:

1	B.Sc. (Hons.) Agriculture
In addition: Any other Agriculture related program as referred by Academic Council	

MAIN FUNCTIONS:

a) To prepare syllabi for various Programmes in line with the Vision, Mission and Objectives of the university/ department, interest of all stakeholders, including employers and national requirements, for consideration and approval of the Academic Council
b) To suggest methods and methodologies for innovative teaching and evaluation techniques
c) To coordinate research, teaching and extension/ outreach activities in the university/ department
d) To suggest to Academic Council, an expert panel of faculty members for Q-Paper setters; Evaluators and for examining the lab courses
e) Any other assignment, as referred to, by the MRSPTU Academic Council

QUORUM:

Quorum of the BoS meeting shall be minimum of half of the members of the BoS constituted including the Chairperson of the BoS.

In case of Change of Head of Deptt during the tenure period of BoS, the new appointed Head of Deptt shall take over as Chairperson of BoS ex-officio. The term of members expires after two years from the date of notification or till they hold official positions as above, whichever is earlier.

13/8/21

DEAN ACADEMIC AFFAIRS
(Savina Bansal)

Endst. No. DAA/MRSPTU/NOTIFICATION/115/1-4 Dated: 13-08-2021

Forwarded to the following for information and further necessary action please:

1. Hon'ble Vice Chancellor *cum* Chairman Academic Council MRSPTU, Bathinda
2. Registrar *cum* Member Secretary BoG of MRSPTU Bathinda
3. Dean Academics, MRSPTU Bathinda
4. All Concerned

ਐਸੋ. ਡੀਨ (ਅਕਾਦਮਿਕ ਮਾਮਲੇ) **Associate Dean (Academic Affairs)**

Ref. No.: DAA/MRSPTU/2023/ 4301 **Date:** 19.09.2023

NOTIFICATION

Consequent upon the approval of the competent authority vide e-office File No. I-15/1258/2023-DEAN ACAD-MRSPTU-BTD (Computer No. 109971) dated 18.09.2023, the tenure of Board of Studies in Agriculture Sciences of Maharaja Ranjit Singh Punjab Technical University, Bathinda has been extended upto 08.08.2024 for uninterrupted academic work.

Dr. Wineet Chawala, Assistant Professor, School of Agriculture Engineering & Technology has newly joined the department. Thus, his name has been included as co-opted member in this BoS.

Associate Dean (Academic Affairs),
MRSPTU, Bathinda

Copy to:

1. PA to Vice Chancellor, MRSPTU, Bathinda for information to the Vice Chancellor, please.
2. Registrar, MRSPTU, Bathinda
3. Chairperson BoS in Agriculture Sciences
4. Dr. Wineet Chawala, Assistant Professor, School of Agriculture Engineering & Technology, MRSPTU
5. All concerned members

File No. I-25/131/2023-PSAEC-PATIALA

Autonomous

Universities of Punjab

UNI-MRSPTU-BTD

PSAEC-PATIALA

SUBJECT

Main Category	:	
Sub Category	:	
Description	:	Approval for increase in sanctioned intake of BMS (Airlines, Tourism & Hospitality) (Three Years Course) at PSAEC Patiala from existing 40 to 60.

OTHER DETAILS

Language	:	English
Remarks	:	Approval for increase in sanctioned intake of BMS (Airlines, Tourism & Hospitality) (Three Years Course) at PSAEC Patiala from existing 40 to 60

No correspondence is attached in this file.

Note No. #1

Subject: Approval for increase in sanctioned intake of BMS (Airlines, Tourism & Hospitality) (Three Years Course) at PSAEC Patiala from existing 40 to 60- Regarding.

Dear Sir,

This is in reference to the subject matter regarding approval of increase in sanctioned intake for Bachelor of Management Studies (Airlines, Tourism & Hospitality) three years duration course, at PSAEC Patiala as the number of admitted students as on today is 50 against sanctioned intake of 40 and approximately two more admissions are expected before expiry of admissions deadline i.e., 15/09/2023.

If needed this item may kindly be taken to "Academic Council Meeting " scheduled on 26/09/2023 as an agenda item for approval. The agenda item is given below: -

Agenda Item .... : At Punjab State Aeronautical Engineering College Patiala, the sanctioned intake for BMS (Airlines, Tourism and Hospitality) is 40 seats, while during this ongoing academic year 2023-2024, the admitted student's strength is 50 due to aggressive admissions campaign by PSAEC Patiala Team. It is proposed that sanctioned intake of BMS may kindly be increased from existing 40 to 60 for this BMS (Airlines, Tourism and Hospitality) course at PSAEC Patiala.

Submitted for approval please.

13/09/2023 12:05 PM

BALRAJ SINGH SIDHU
(DIRECTOR-PSAEC PATIALA)

Note No. #2

Submitted for your consideration and kind approval, please.

13/09/2023 12:11 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

Note No. #3

Approved.

13/09/2023 1:28 PM

BUTA SINGH SIDHU
(VICE CHANCELLOR-MRSPTU-BTD)

Note No. #4

Forwarded for further necessary action.

13/09/2023 2:57 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

Note No. #5

Seats updated on University website.

13/09/2023 3:33 PM

TARUN BANSAL
(CDEO(DEAN ACADEMIC OFFICE)-MRSPTU-BTD)

Note No. #6

Needful done.

13/09/2023 3:37 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

File No. I-15/1161/2023-DEAN ACAD-MRSPTU-BTD

Autonomous

Universities of Punjab

UNI-MRSPTU-BTD

O/o DEAN ACADEMIC-MRSPTU-BATHINDA

SUBJECT

Main Category	:	Migration
Sub Category	:	
Description	:	Inter-University Migration of Mr. Panshul Gupta in 3rd Semester B.Tech(CSE) from Chandigarh University to Asra College of Engg. & Tech., Bhawanigarh (under MRSPTU, Bathinda).

OTHER DETAILS

Language	:	English
Remarks	:	

To

Hon'ble Vise Chancellor

Punjab Technical University

Bathinda.

Subject:- **Request Regarding Migration from Chandigarh University to PTU Bathinda in the 2nd year of B.Tech (Computer Science)**

Respected Sir,

I have applied for the migration as mention above through the Asra Group of Colleges but the same was rejected by the PTU due to known submission of NOC from Chandigarh University.

Sir, Now I have submit the NOC of Chandigarh University through Asra Group of Colleges and I also requested to your goodself, please allot me any other subject instead of Math in which I have got the compartment. I undertake to qualify that subject alongwith the 2nd year of B.Tech (Computer Science).

I highly grateful and humbly requested please allow the migration keeping in view of my circumstances.

Thanking You,

Date: 21/08/2023

Yours sincerely

Panshul Gupta

(Panshul Gupta)
S/o J.K. Gupta
36, New Mehar Singh Colony
Patiala.
M.No. 9115161377

Copy to: Chairman Asra Group of Colleges Bhawanigarh with a request please undertake my migration case with the PTU Bathinda.

No Dues Without fine.

Library Tickets Were Not issued.

1. THE LIBRARY TICKETS ....0........NOS
   HAVE BEEN RECEIVED BACK
2. FINE AMOUNTS TO Rs. ——
   HAS BEEN CHARTED FOR MISSING TICKETS/
   I-CARD/BOOKS CGST ETC. ——

Asstt. Librarian (I-C)
E- 14744

No Documents pending
Kaur
E 3167
22/6/23
12:31 pm

No Dues Without fine.
Library Tickets Were Not issued.

1. THE LIBRARY TICKETS ......0...... NOS
HAVE BEEN RECEIVED BACK
2. FINE AMOUNTS TO Rs. —
HAS BEEN CHARTED FOR MISSING TICKETS/
I-CARD/BOOKS CGST ETC. —

Asstt. Librarian (I/C)
E- 14744

No Documents pending
E3167
22/6/23
12:31 PM

8/31/23, 12:45 PM

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CU CHANDIGARH UNIVERSITY

CHANDIGARH UNIVERSITY
Discover. Learn. Empower.

Seat to be Cancelled

2-PD.
84.01

NAAC GRADE A+
Accredited University

FOR REGULAR STUDENT (WHO WANT TO TAKE SEMESTER /NO DUES CERTIFICATE/ YEAR BACK /LEAVE)

Ref. No: - CU/R/NOC/ 2022-23/8278

Date 22-06-23
Time 10:25

Panshul Gupta
Student Signature

To
The Registrar
Chandigarh University,
Gharuan, Mohali

I am aware of my reappear of second sem in Mathematics please cancel my seat i will be responsible for that. Panshul Gupta

Subject: -No Dues Certificate.

Sir,
I, Mr. / Ms. Panshul Gupta S/D/o Mr. / Ms. Jatinder Gupta
Bearing UID No 22BCC70067 Course B.tech Branch C.S.E-C.C Batch 2022

Request your kind self to grant me necessary 'No Dues Certificate'
I hereby undertake that there is nothing dues against me in the University. Even if, any due is reported against me. I shall be liable to pay within a week from the date of intimation.

Panshul Gupta (9115161377)
Student Signature
(with mobile number)

Cancelled

Parent/Guardian Signature

The Student is recommended to withdraw his/her seat as CU Norms

Remarks: -

Ramandeep E10321

(1) Academic Coordinator
(Signature with Stamp & E-Code)

Associate Director
Gharuan

(2) Head of Department
(Signature with Stamp & E-Code)

E11953

Candidate to submit the NOC from the following :-

E1761
(3) Department & Central Library
(Signature with Stamp & E-Code)

Knowledge Resource Centre
Chandigarh University

22/6/2023
(4) Department Student Welfare
(Signature with Stamp & E-Code)
(Sports) (Academic Block-B3)

Sr. Manager Student Care
Department of Student Welfare
Chandigarh University

E9463
22-06-2023
~~E15507~~ — Rajat Garg
E15457 22/06/23
(5) Accounts Section
(Signature with Stamp & E-Code)
(Academic Block-B3)

E1186
(6) Hostel Warden
(Signature with Stamp & E-Code)

B. Singh
22/6/23
(7) Transport Manager
(Signature with Stamp & E-Code)
(Near HDFC Bank)

E10935 26/7/23
(8) Registration Office
(General/OBC Category- Academic Block-B1, Room No-208)(SC Category-Academic Block-B1), Room No-204)

Registrar
Chandigarh University
Gharuan, Mohali-140413
26/7/23
(9) REGISTRAR
(Academic Block-B1, Room No-207)

NOTE: - STUDENT SHOULD KEEP THE COPY OF THIS NOC FOR FUTURE REFERENCE

https://mail.google.com/mail/u/0/#inbox/FMfcgzGtwqPTLCsmFDfKnWMKmPkPQPdF?projector=1&messagePartId=0.1

1/1

8/31/23, 12:45 PM IMG-20230831-WA0030.jpg

CHANDIGARH UNIVERSITY
Discover. Learn. Empower.

NAAC GRADE A+
Accredited University

Seat to be cancelled
2-1 ...
84.01

FOR REGULAR STUDENT (WHO WANT TO TAKE SEMESTER /NO DUES CERTIFICATE/ YEAR BACK /LEAVE)

Ref. No: - CU/R/NOC/ 2022-23/8278

Date 22-06-23
Time 10:25

To
The Registrar
Chandigarh University,
Gharuan, Mohali

I am aware of my reappear of second sem in Mathematics please cancel my seat i will be responsible for that. Panshul Gupta

Panshul Gupta
Student Signature

Subject: -No Dues Certificate.

Sir,
I, Mr. / Ms. Panshul Gupta S/D/o Mr. / Ms. Jatinder Gupta
Bearing UID No 22BCC70067 Course B.tech Branch C.S.E-C.C Batch 2022

Request your kind self to grant me necessary **'No Dues Certificate'**
I hereby undertake that there is nothing dues against me in the University. Even if, any due is reported against me. I shall be liable to pay within a week from the date of intimation.

Panshul Gupta (9115161377)
Student Signature
(with mobile number)

Cancelled

Parent/Guardian Signature

The Student is recommended to withdraw his/her seat as CU Norms

Remarks: -

E103...

(1) Academic Coordinator
(Signature with Stamp & E-Code)

Associate Director Academic Units (AU-1-5) CU Gharuan
E1193

(2) Head of Department
(Signature with Stamp & E-Code)

Candidate to submit the NOC from the following :-

E1761

(3) Department & Central Library
(Signature with Stamp & E-Code)

22/6/2023

Sr. Manager Student Care
Department of Students' Welfare
Chandigarh University

(4) Department Student Welfare
(Signature with Stamp & E-Code)
(Sports) (Academic Block-B3)

Nil
E9467
22-06-2023
~~E15501~~ Rajat Garg
E15457 22/06/23

(5) Accounts Section
(Signature with Stamp & E-Code)
(Academic Block-B3)

E1...

(6) Hostel Warden
(Signature with Stamp & E-Code)

B. Singh
22/6/23

(7) Transport Manager
(Signature with Stamp & E-Code)
(Near HDFC Bank)

E10935 26/7/23

(8) Registration Office
(General/OBC Category- Academic Block-B1, Room No-208)(SC Category-Academic Block-B1), Room No-204)

Registrar
Chandigarh University
Gharuan, Mohali-140413
26/7/23

(9) REGISTRAR
(Academic Block-B1, Room No-207)

NOTE: - STUDENT SHOULD KEEP THE COPY OF THIS NOC FOR FUTURE REFERENCE

https://mail.google.com/mail/u/0/#inbox/FMfcgzGtwqPTLCsmFDfKnWMKmPkPQPdF?projector=1&messagePartId=0.1 1/1

5/10/23, 2:10 PM

Chandigarh University Management System

CUIMS

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Counseling Therapy Clinic Registration (frmAppCounsellingTherapyClinicReg
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General Proficiency Choice (frmGeneralProficiencyCoursesForStu
Global Programs Survey (frmGlobalProgramsSurvey.aspx)
Library
My Profile (frmStudentProfile.aspx)
Online Test (frmTakeTest.aspx)
Student Relation Management System

Important Links

CU Live

Anti Ragging

Fe[...]ment

PANSHUL

Student Center (StudentHome.aspx)

My University Email

Start Date:Jan 4 2019 2:00PM and End Date:Jan 1 2025 12:00AM

Result Type | Final

SHOW RESULT PRINT

Student's Final Result

(for any query you can email at **feedback.exam@cumail.in**)

CS204-BACHELOR OF ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING (HONS.) IBM-CLOUD COMPUTING

UID 22BCC70067

Name PANSHUL GUPTA

Father's Name JATINDER GUPTA

Mother's Name SEEMA GUPTA

CGPA 6.19

Semester : 1 SGPA : 6.19

Subject Code	Subject Name	Credits	Grade
22CSH-101	Introduction to Problem Solving	4.00	C+
22CSP-102	Workshop Technology	1.00	C+
22ECH-101	Digital Electronics	4.00	C+
22ECH-102	Disruptive Technologies -1	2.00	B
22GPT-121	General Proficiency-1	1.00	C+
22PCH-105	Communication Skills	3.00	B
22SMT-121	MATHEMATICS -I	4.00	C
22SZT-148	Biology for Engineers	3.00	C+
22UCT-101	Design Thinking and creativity for innovation	2.00	B
22UCT-103	Universal Human Values, Ethics and Life Skills-1	2.00	B

Panshul Gupta

https://uims.cuchd.in/uims/result.aspx

1/2

5/10/23, 2:10 PM

Chandigarh University Management System

2

CUIMS

Academics

Accounts

Administration

Admission Referral Form (frmAdmissionReferral.aspx)

Apply for Loan Documents (frmLoanLetterApplication.aspx)

Club Activities (frmresources.aspx?type=iQsF630wMB2Apcb05DQGhw==

Counseling Therapy Clinic Registration (frmAppCounsellingTherapyClinicRegi

DCPD

E Library

Examination

General Proficiency Choice (frmGeneralProficiencyCoursesForStu

Global Programs Survey (frmGlobalProgramsSurvey.aspx)

Library

My Profile (frmStudentProfile.aspx)

Online Test (frmTakeTest.aspx)

Student Relation Management System

Disclaimer: Chandigarh University is not responsible for any inadvertent error that may have crept in the results being published on the UIMS. The results published on the UIMS are for immediate information to the examinees & not for legal purpose. These cannot be treated as original marks. Original marks shall be issued by the University separately. In case of any discrepancy, University records shall be final. For any query you can email at **feedback.exam@cumail.in** ANSHUL

(StudentHome.aspx)

Chandigarh University, Gharuan
General Helpline No +91-160-3051003, +91-160-3014444
Wifi Hostels Helpline No. 7347017909
(Mr. Jaspreet Singh)

Report a Bug (bugreport.aspx)

Pankaj Gupta

https://uims.cuchd.in/uims/result.aspx

2/2

3

ASRA COLLEGE Of ENGINEERING & TECHNOLOGY

Campus: NH-7, Patiala-Sangrur Road, Vill. Rajpura, P.O. Nadampur, Teh. Bhawanigarh, Distt. Sangrur (Pb.)
Mob. 97819-97327, 97819-86327
e-mail: asracollege27@gmail.com website: www.asracollege.edu.in

Ref. No. ASRA/ACET/ 7011

Date:- 05-06-2023

To
The Dean Academics,
MRSPTU Bathinda.

Subject: Regarding NOC for Inter-University Migration.

Respected Sir,

It is stated Mr. Panshul Gupta studying at Chandigarh University in B.Tech CSE First Year wants to get migrated to Asra College of Engg. & Tech.in B.Tech CSE under MRSPTU in 2nd Year i.e. 3rd Semester. **The Institute has No Objection** if the University permit the student to have migration to our college as we have a vacant seat in Third Semester for the same.

With regards

Director/Principal

Director
Asra College of Engg. & Technology
Bhawanigarh.

4

Parshul Gupta
Date of Birth/DOB: 07/07/2003
Male/ MALE

6251 1272 4872

VID : [illegible]

मेरा आधार, मेरी पहचान

Unique Identification Authority of India

Address:
S/O Jatinder Kumar Gupta, 36, NEW MEHAR SINGH COLONY, Patiala, Patiala, Punjab - 147001

6251 1272 4872

VID : 9169 1761 5784 8276

Parshul Gupta

Note No. #1

Sub.: Inter-University Migration of Mr. Panshul Gupta in 3rd Semester B.Tech(CSE) from Chandigarh University to Asra College of Engg. & Tech., Bhawanigarh (under MRSPTU, Bathinda).

A request was received from Asra College of Engg.& Tech. through E-mail on 31.08.2023 of Mr. Panshul Gupta for Inter-University migration from Chandigarh University on the grounds of personal/family problems in 3rd semester of B.Tech(CSE) in Asra College of Engg.& Tech. (under MRSPTU, Bathinda). In this request, student has attached NOCs from both the colleges/Institutes.
Further, it is mentioned that as per the first year results attached by the student, he has one reappear in Mathematics-II in 2nd semester.
Moreover, as the application received the student has given undertaking to quality that subject alongwith the 2nd year of B.Tech (CSE).

Whereas, as per the Migration Regulations of the MRSPTU, Bathinda
Point no. 5(C)
Sub point no. (ii) *The candidate should have passed all the courses of the first year of his/her Programme the University form where he/she wants to migrate.*

Sub point no. (vi) *The syllabus of the other University should be mapped 70% with the syllabus of MRSPTU, Bathinda before migration to be allowed to the student.*

Sub point no. (vii) *After mapping of the syllabus of other University with syllabus of MRSPTU, if it is found that 70% of syllabus is not similar/equivalent to the syllabus of MRSPTU, the student will be allowed to migrate if he/she agrees to take bridge course/repeat the course of deficit subjects.*

The case may be allowed as per the
Point no. 6
Power of Relaxation:
"***Notwithstanding the existing Migration Regulations, the Vice-Chancellor in matters of exigency, to be recorded in writing, shall be authorized to consider migration on compassionate grounds for the cases that are not otherwise covered under Migration Regulations, to be ratified by BOG".***

It is worth mentioning that for processing this case, it may be forwarded to CoE, MRSPTU for comments regarding conducting the reappear and issuing the DMC/Degree to student.

The case is submitted for your perusal and directions please.

31/08/2023 3:51 PM

SIMRANJEET KAUR
(CLERK(ACADEMICS)-MRSPTU)

Note No. #2

Before processing the case, as a special case, the comments of COE, MRSPTU are required so that the student may not face any problem in future.

31/08/2023 4:57 PM

SATNAM SINGH
(ASST. DEAN(ACADEMICS)-MRSPTU)

Note No. #3

Please give your comments as per NOTE#2.

31/08/2023 5:04 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

Note No. #4

Student should be informed that either he has to clear his reappear from Chandigarh University OR he can clear the reappear in MRSPTU for which he will be given a separate DMC of MRSPTU (2nd semester) showing only that subject of reappear.

04/09/2023 11:16 AM

KARANVIR SINGH
(CONTROLLER OF EXAMINATION-MRSPTU-BTD)

Note No. #5

The student will be informed as per the comments of CoE at Note#04.
This case shall not be used as precedent for future cases.
Recommended and submitted for your kind approval, as a special case.

04/09/2023 11:58 AM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

Note No. #6

Approved as proposed.

04/09/2023 12:25 PM

BUTA SINGH SIDHU
(VICE CHANCELLOR-MRSPTU-BTD)

Note No. #7

To prepare the order.

04/09/2023 12:45 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

File No. I-15/1235/2023-DEAN ACAD-MRSPTU-BTD

Autonomous

Universities of Punjab

MAHARAJA RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY-BATHINDA

O/o DEAN ACADEMIC-MRSPTU-BATHINDA

SUBJECT

Main Category	:	Migration
Sub Category	:	
Description	:	Sub. Regarding migration of student Mr. Vansh Jindal from Nirman Campus of Education, Research & Training, Sunam (under MRSPTU, Bathinda) to KCT College of Engg. & Tech., Fatehgarh (under MRSPTU, Bathinda).

OTHER DETAILS

Language	:	English
Remarks	:	

ਸੇਵਾ ਵਿਖੇ

ਡੀਨ ਅਕਾਦਮਿਕ
MRSPTU
BATHINDA

ਵਿਸ਼ਾ:- Migration ਕਰਵਾਉਣ ਸੰਬੰਧੀ।

ਬੇਨਤੀ ਹੈ ਕਿ ਮੈਂਨੇ 2022 ਵਿੱਚ ਗਿਆਨੀ ਕੈਂਪਸ ਆਫ਼ ਐਜੂਕੇਸ਼ਨ ਵਿਖੇ BCA ਕੋਰਸ ਵਿੱਚ ਦਾਖਲਾ ਲਿਆ ਸੀ। ਮੇਰਾ ਯੂਨੀਵਰਸਿਟੀ ਰੋਲ ਨੰ 220232281 ਹੈ। ਬੇਨਤੀ ਹੈ ਕਿ ਹੁਣ ਮੇਰੇ ਦਾਦਾ ਜੀ ਦੀ ਸਿਹਤ ਠੀਕ ਨਹੀਂ ਜਿਸ ਕਰਕੇ ਮੈਨੂੰ ਹੁਣ ਬਠਿੰਡਾ ਵਿਖੇ ਰਹਿਣਾ ਪੈ ਰਿਹਾ ਹੈ। ਬਠਿੰਡਾ ਸ਼ਹਿਰ ਤੋਂ ਗਿਆਨੀ ਕੈਂਪਸ ਦੀ ਦੂਰੀ ਜ਼ਿਆਦਾ ਹੈ ਅਤੇ ਮੇਰੇ ਲਿਏ ਰੋਜ਼ ਰੋਜ਼ ਜਾਣਾ ਆਉਣਾ ਮੁਸ਼ਕਿਲ ਹੈ। ਇਸ ਕਰਕੇ ਮੈਂ ਆਪਣੀ Migration KCT ਕਾਲਜ ਆਫ਼ ਇੰਜੀਨੀਅਰਿੰਗ ਵਿਖੇ ਕਰਵਾਉਣਾ ਚਾਹ ਰਿਹਾ ਹਾਂ ਕਿਉਂਕਿ ਉਸ ਦੀ ਦੂਰੀ ਘਰ ਤੋਂ ਸਿਰਫ 6 km ਹੈ। ਇਸ ਲਈ ਮੈਂ ਬੇਨਤੀ ਕਰਦਾ ਹਾਂ ਕਿ ਮੇਰੀ Migration ਕੀਤੀ ਜਾਵੇ ਤਾਂ ਜੋ ਮੈਂ ਆਪਣੀ ਪੜ੍ਹਾਈ ਜਾਰੀ ਰੱਖ ਸਕਾਂ।

ਬੇਨਤੀ ਕਰਤਾ

Vansh JINDAL
220232281
BCA 3rd Sem

Appendix-1 (Common)
(Refer to Para 8 of the Migration Regulations)
MAHARAJ RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY
Application Form for Migration to 3rd Semester

1. Name (In Capital Letters) : VANSH JINDAL
2. Father's Name : RAM NARAIN
3. Mother's Name : SANGEETA GARG
4. College Roll No. : 9214
5. Name of the parent College/Programme/ Semester/University Roll No. with documentary proof. : nirman campus of education, Research and training /220232281/ Bachelor of computer applications.
6. Mode of Admission/Admission through : ....
   Tuition fee waiver or not ....
7. Last Examination of this University (in which appeared/pass/fail)
   (a) Name of the Last Examination : Bachelor of computer applications [Sem-II
   (b) Year/Session/Semester : 2022-23
   (C) Result : Awaited
8. Give the reasons for seeking migration : ....
9. Distance between the Parent Institute and the Institute where migration is sought : 20 Km
10. Name of the College/University To which migration is sought. : KCT College of Engg. & Tech/MRSPTU
11. Payment of Migration Application Processing Fees : Rs. ....
    University Receipt No./Bank Draft No. with Date : ....
12. Full Address of the Applicant (with Mobile No.)
    #187, Ward No. 12, Dashmesh colony, Cinema road, Sunam (Sangrur). Mob. 80548-68000

Vansh Jindal
Signature of the Candidate

Date: ....

Dean Academic Affairs
Maharaja Ranjit Singh
Punjab Technical University
Bathinda

Note: Attach (Appendix-2) NOC from both the Institutes i.e. from where migration is sought and to where migration is required and Character Certificate from parent Institute.

Appendix-2

(Refer to Para 5 (a)of the Migration Regulations)

MAHARAJ RANJIT SINGH PUNJAB TECHNICAL UNIVERSITY, BATHINDA

NO OBJECTION CERTIFICATE

(Issued by the Principal of the College from where the student seeks migration)

Ref. No: 239 **Date:** 11-8-2023

This is to certify that Mr./Ms. VANSH JINDAL S/d/o. RAM NARAIN University Roll No. 2202322281 is a regular student of this College in BCA Discipline / Programme / Branch. She/he has applied for migration to KCT Group OF Institutions to 3rd semester under Maharaja Ranjit Singh Punjab Technical University, Bathinda. This College has no objection to her/his migration out of this College.

(a) The student is eligible to register for BC.A 3rd semester commencing from August 01, 2023

(b) She/he has cleared all his/her subjects of first year or She/he has following subject/subjects not cleared as on today He has cleared all his subjects of first year in B.C.A.

(c) There are no College dues pending against the student as on today.

(d) The student attended workshop training during summer vacation of 20........ and her/his performance shall be forwarded to the receiving college by 31st August, 20 .

Note: The Principal/Director must issue NOC or send his observations to the MRSPTU within 10 days of the submission of application by the student.

Principal
Nirman Campus of Education,
Research & Training
Bakhtour Nagar, Jakhepal Road,
Sunam-148028 (Sangrur) Pb.

Signature of the Principal with seal

NO OBJECTION CERTIFICATE

(Issued by the Principal of the College to which the student seeks migration)

Ref. No: **Date:** 11/8/2023

(a) This is to certify that this institute has 16 (number) of seats vacant in BCA Programme/Discipline.

(b) This is also to certify that this institution has no objection to the migration of Mr/Miss. VANSH JINDAL S/D/o. RAM NARAIN University Roll No. 2202322281 Student of Nirman campus of education College (parent College) Jakhepal road, Sunam Programme/Discipline/Branch BCA to this College.

Principal
KCT College of Engg. & Tech.
Fatehgarh (Sangrur)
11/8/23

Signature of the Principal with seal

MIGRATION REGULATIONS, MRSPTU

सत्यमेव जयते
भारत सरकार

आधार

ਭਾਰਤ ਸਰਕਾਰ
Government of India

ਭਾਰਤੀ ਵਿਲੱਖਣ ਪਛਾਣ ਅਥਾਰਟੀ
Unique Identification Authority of India

ਨਾਮਜਦਗੀ ਨੰਬਰ/ Enrolment No.: 2309/22085/04681

Download Date: 20/10/2021

To
ਵੰਸ਼ ਜਿੰਦਲ
Vansh Jindal
C/O: Ram Narain
187 Ward No 12
Dashmesh Colony, Cinema Road
Sunam
Sunam
Sangrur Punjab - 148028
8054868000

Issue Date: 11/10/2021

Validity unknown
Digitally signed by UNIQUE IDENTIFICATION AUTHORITY OF INDIA 05
Date: 2021.10.20 29:00 IST

ਤੁਹਾਡਾ ਆਧਾਰ ਨੰਬਰ / Your Aadhaar No. :
6716 0393 4976
VID : 9159 2802 9707 1407

ਮੇਰਾ ਆਧਾਰ, ਮੇਰੀ ਪਛਾਣ

ਭਾਰਤ ਸਰਕਾਰ
Government of India
ਆਧਾਰ

Download Date: 20/10/2021

ਵੰਸ਼ ਜਿੰਦਲ
Vansh Jindal
ਜਨਮ ਮਿਤੀ/DOB: 16/03/2005
ਮਰਦ/ MALE

Issue Date: 11/10/2021

6716 0393 4976
VID : 9159 2802 9707 1407

ਮੇਰਾ ਆਧਾਰ, ਮੇਰੀ ਪਛਾਣ

Government of India

AADHAAR

ਸੂਚਨਾ
- ਆਧਾਰ ਪਛਾਣ ਦਾ ਸਬੂਤ ਹੈ, ਨਾਗਰਿਕਤਾ ਦਾ ਨਹੀਂ
- ਪਛਾਣ ਦੀ ਪੁਸ਼ਟੀ ਲਈ, ਸੁਰੱਖਿਅਤ QR ਕੋਡ / ਔਫਲਾਈਨ XML / ਔਨਲਾਈਨ ਪ੍ਰਮਾਣੀਕਰਨ ਦੀ ਵਰਤੋ ਕਰੋ
- ਇਹ ਇਕ ਇਲੈਕਟ੍ਰੋਨਿਕ ਪ੍ਰਕਿਰਿਆ ਦੁਆਰਾ ਬਣਿਆ ਹੋਇਆ ਪੱਤਰ ਹੈ

INFORMATION
- Aadhaar is a proof of identity, not of citizenship.
- Verify identity using Secure QR Code/ Offline XML/ Online Authentication.
- This is electronically generated letter.

- ਆਧਾਰ ਦੇਸ਼ ਭਰ ਵਿੱਚ ਪ੍ਰਮਾਣਿਤ ਹੈ
- ਆਧਾਰ ਤੁਹਾਨੂੰ ਆਸਾਨੀ ਨਾਲ ਕਈ ਸਰਕਾਰੀ ਅਤੇ ਗੈਰ ਸਰਕਾਰੀ ਸੇਵਾਵਾਂ ਦਾ ਲਾਭ ਲੈਣ ਵਿੱਚ ਸਹਾਇਤਾ ਕਰਦਾ ਹੈ
- ਆਪਣੇ ਮੋਬਾਇਲ ਨੰਬਰ ਅਤੇ ਈਮੇਲ ਆਈਡੀ ਨੂੰ ਆਧਾਰ ਵਿੱਚ ਅਪਡੇਟ ਰੱਖੋ
- mAadhaar ਐਪ ਦੀ ਵਰਤੋਂ ਕਰਕੇ, ਆਧਾਰ ਨੂੰ ਆਪਣੇ ਸਮਾਰਟ ਫੋਨ ਵਿੱਚ ਰੱਖੋ

- Aadhaar is valid throughout the country.
- Aadhaar helps you avail various Government and non-Government services easily.
- Keep your mobile number & email ID updated in Aadhaar.
- Carry Aadhaar in your smart phone – use mAadhaar App.

ਭਾਰਤੀ ਵਿਲੱਖਣ ਪਛਾਣ ਅਥਾਰਟੀ
Unique Identification Authority of India
ਆਧਾਰ

ਪਤਾ:
ਸਰਪ੍ਰਸਤ: ਰਾਮ ਨਾਰਾਇਣ, # 187 ਵਾਰਡ ਨ 12, ਦਸ਼ਮੇਸ਼ ਕਲੋਨੀ, ਸਿਨੇਮਾ ਰੋਡ, ਸੁਨਾਮ, ਸੰਗਰੂਰ,
ਪੰਜਾਬ - 148028

Address:
C/O: Ram Narain, # 187 Ward No 12,
Dashmesh Colony, Cinema Road, Sunam,
Sangrur,
Punjab - 148028

6716 0393 4976
VID : 9159 2802 9707 1407

1947 | help@uidai.gov.in | www.uidai.gov.in

Nirman Campus of Education, Research & Training, Sunam

CHARACTER CERTIFICATE

This is to certify that I know Shri/Smt./Ku. VANSH JINDAL S/o/D/O of Shri RAM NARAIN Student of B.C.A for the last One years. Shri/Smt./Ku. VANSH JINDAL bears good moral character and to the best of my knowledge is not involved in any criminal activity and no personal legal case is pending against him/her.

Signature with Seal

Principal
Nirman Campus of Education,
Research & Training
Bakhtour Nagar, Jakhepal Road,
Sunam-148028 (Sangrur) Pb.

MRSPTU
Bathinda

Dean Academic Affairs MRSPTU <daa@mrsptu.ac.in>

Results of Vansh Jindal(Migration)

1 message

Dean <dean@kctgroups.com>
To: daa@mrsptu.ac.in

Fri, Sep 8, 2023 at 11:42 AM

Respected Sir

As discuss we are sending the results (1sem and 2nd sem) of Vansh Jindal of BCA for the migration. Please find attachments.

2 attachments

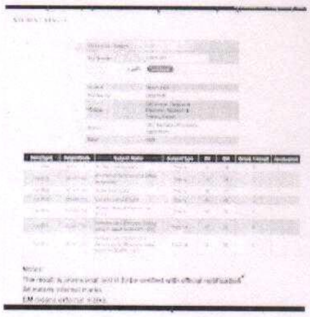

PHOTO-2023-09-08-11-37-44.jpg
116K

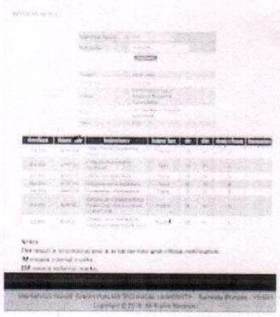

PHOTO-2023-09-08-11-37-44.jpg
132K

9/8/23, 4:22 PM PHOTO-2023-09-08-11-37-44.jpg

STUDENT RESULT

*Select Exam Session	Dec 2022
*Roll Number	220232281
	View Result

*Student	Vansh Jindal
*Roll Number	220232281
*College	246 Nirman Campus of Education, Research & Training,Sunam
*Branch	1601 Bachelor of Computer Applications
*Batch	2022

Sem (Type)	SubjectCode	Subject Name	Subject Type	IM	EM	Grade / Result	Revaluation
1st (RG)	BCAP1101	Problem Solving using C	Theory	33	28	B	
1st (RG)	BCAP1102	Information Technology & Office Automation	Theory	32	24	C	
1st (RG)	BCAP1103	Digital Electronics	Theory	32	21	C	
1st (RG)	BHUM0101	Communicative English	Theory	34	20	C	
1st (RG)	BHUM0103	Human Values & Professional Ethics	Theory	35	26	B	
1st (RG)	BCAP1104	Software Lab I (Problem Solving using C based on BCAP1-101)	Practical	52	33	A	
1st (RG)	BCAP1105	Software Lab II (Information Technology & Office Automation based on BCAP1- 102)	Practical	54	32	A	

Notes:

The result is provisional and is to be verified with official notification.

IM means internal marks.

EM means external marks.

https://mail.google.com/mail/u/0/#inbox/FMfcgzGtwznFJQsjcPPHwjjBthkJdsGV?projector=1&messagePartId=0.1 1/1

STUDENT RESULT

*Select Exam Session	May 2023
*Roll Number	220232281
	View Result

*Student	Vansh Jindal
*Roll Number	220232281
*College	246 Nirman Campus of Education, Research & Training,Sunam
*Branch	1601 Bachelor of Computer Applications
*Batch	2022

Sem (Type)	SubjectCode	Subject Name	Subject Type	IM	EM	Grade / Result	Revaluation
2nd (RG)	BCAP1206	Object Oriented Programming Using C ++	Theory	33	16	D	
2nd (RG)	BCAP1207	Computer Organization & Architecture	Theory	31	21	C	
2nd (RG)	BCAP1208	Internet & its Applications	Theory	34	19	C	
2nd (RG)	BCAP1209	Multimedia and its Applications	Theory	33	29	B	
2nd (RG)	BMAT0204	Fundamentals of Mathematics	Theory	31	32	B	
2nd (RG)	BCAP1210	Software Lab-III (Object Oriented Programming Using C ++ based on BCAP1206)	Practical	53	32	A	
2nd (RG)	BCAP1211	Software Lab-IV (Internet & Its Applications based on BCAP1208)	Practical	52	31	A	

Notes:

The result is provisional and is to be verified with official notification.

IM means internal marks.

EM means external marks.

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KCT COLLEGE OF ENGINEERING & TECHNOLOGY
HARYAU

HARYAU - 148031

K16817

AUTHORISED SIGNATORIES
Please sign above

REF. No. 388513000654

⑈000733⑈ 148240254⑆ 999990⑈ 16

Note No. #1

Sub. Regarding migration of student Mr. Vansh Jindal from Nirman Campus of Education, Research & Training, Sunam (under MRSPTU, Bathinda) to KCT College of Engg. & Tech., Fatehgarh (under MRSPTU, Bathinda).

Placed herewith the request received from the following student seeking migration from Nirman Campus of Education, Research & Training, Sunam (under MRSPTU, Bathinda) to KCT College of Engg. & Tech., Fatehgarh (under MRSPTU, Bathinda).

Sr.No.	Uni. Roll No.	Name of student	Semester	Parent Institute	Migration Institute
1.	220232281	Vansh Jindal	3rd	Nirman Campus of Education, Research & Training, Sunam	KCT College of Engg. & Tech., Fatehgarh

Whereas, as per the Migration Regulations of the MRSPTU, Bathinda:
"*The inter college migration will be allowed, if the distance between the parent institute and the institute where migration is sought are more than 40 km apart by road*".

As the student is interested to migrate at KCT College of Engg. & Tech., Fatehgarh in the 3rd semester of BCA. The student has submitted NOCs of both the colleges along with the applicable processing fee of Rs. 10,000/- (non-refundable). The condition for the minimum distance of 40km is not fulfilled as per migration rules.

However, the case may be allowed as per the
Point no. 6
Power of Relaxation:
"***Notwithstanding the existing Migration Regulations, the Vice-Chancellor in matters of exigency, to be recorded in writing, shall be authorized to consider migration on compassionate grounds for the cases that are not otherwise covered under Migration Regulations, to be ratified by BOG".***

In view of the problem mentioned by the student and his future, the case of migration be submitted for consideration and approval under the above clause.

14/09/2023 12:51 PM

SIMRANJEET KAUR
(CLERK(ACADEMICS)-MRSPTU)

Note No. #2

The student Vansh Jindal is seeking interuniversity-migration from, 'Nirman Campus of

Education, Research & Training, Sunam' to 'KCT College of Engg. & Tech., Fatehgarh'. The distance between these two colleges is 20KM, which is less than the minimum distance permitted (i.e. 40Km) for inter-university migration.

However, the Honorable Vice Chancellor, under the "Migration Rule (Point-6): The Power of relaxation" are authorized to consider this migration case on compassionate grounds.

Considering the condition of student and for his further studies, the case is submitted for your kind recommendations and approval please.

14/09/2023 3:37 PM

SATNAM SINGH
(ASST. DEAN(ACADEMICS)-MRSPTU)

Note No. #3

Submitted for your kind consideration and approval, please.

14/09/2023 3:43 PM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

Note No. #4

Approved.

14/09/2023 5:34 PM

BUTA SINGH SIDHU
(VICE CHANCELLOR-MRSPTU-BTD)

Note No. #5

To prepare the order.

15/09/2023 11:01 AM

KAWALJIT SINGH SANDHU
(ASSO DEAN(ACADEMICS)-MRSPTU)

ਮਹਾਰਾਜਾ ਰਣਜੀਤ ਸਿੰਘ ਪੰਜਾਬ ਤਕਨੀਕੀ ਯੂਨੀਵਰਸਿਟੀ, ਬਠਿੰਡਾ

ਡੱਬਵਾਲੀ ਰੋਡ, ਬਠਿੰਡਾ - 151001

Maharaja Ranjit Singh Punjab Technical University

DABWALI ROAD, BATHINDA-151001

[A State University Estb. by Govt. of Punjab Act No. 5(2015) u/s 2(f) & Approved u/s 12B of UGC Act, 1956]

ਐਸੋ. ਡੀਨ (ਅਕਾਦਮਿਕ ਮਾਮਲੇ)

Associate Dean (Academic Affairs)

Ref. No.: DAA/MRSPTU/2023/4304

Date: 19.09.2023

MIGRATION ORDER
(Inter-University)

As per the request received from the student for inter-university migration and NoC received form Chandigarh University, Mohali and from Asra College of Engineering & Technology, Bhawanigarh (under MRSPTU Bathinda), the University is pleased to approve the migration of the following student as per the migration regulation 2016.

Name	From			Sem	To		
	University/ college	Branch	Previous Uni. Student ID		University/ college	MRSPTU Roll No.	Branch
Panshul Gupta	Chandigarh University	B.Tech (CSE)	22BCC70067 (Previous Uni. UID ID)	3rd	Asra College of Engg. & Tech., Bhawanigarh	88220280002	B.Tech (CSE)

In addition, the student shall have to qualify the following deficit courses, as reported by the committee constituted for the purpose, as bridge courses.

SNo.	Subject Code	Subject Name	L	T	P	Int.	Ext.	Total
1	BMNCC0-004	Drug Abuse: Problem, Management and Prevention	2	0	0	100	0	100
2	BMNCC0-014	Introduction to Concerned Branch of Engineering	2	0	0	100	0	100
3	BELEE0-102	Basics Electrical Engineering Lab.	0	0	2	60	40	100
4	BMNCC0-010	Universal human Values-I	22hrs (to be completed during 21 days SIP)* Satisfactory/Unsatisfactory					
5	BELEE0-101	Basics Electrical Engineering	3	1	0	40	60	100
6	BCHEM0-101	Chemistry-I	3	1	0	40	60	100
7	BCHEM0-102	Chemistry-I Lab	0	0	2	60	40	100
8	BMATH1-201	Mathematics-II (Probability and Statistics)	3	1	0	40	60	100

The approval has been given subject to the following conditions.

1) The student has to clear his reappear for Mathematics-II in 2nd semester in MRSPTU for which he will be given a separate DMC of MRSPTU (2nd semester) showing only that subject of reappear.
2) The student is required to deposit the 3rd semester fee in the new Institute.
3) The institute must ensure that extra classes be arranged to full-fill the attendance requirement.
4) The receiving college must confirm the date of reporting of the student to all concerned and the status of Bridge Courses/Subjects is under.

Associate Dean (Academic Affairs)
MRSPTU, Bathinda

Copy to:

1. PA to Vice Chancellor, MRSPTU, Bathinda for information to the Vice Chancellor please
2. Registrar, MRSPTU, Bathinda
3. Controller of Examination, MRSPTU, Bathinda for further necessary action please
4. Prof. Incharge (Finance), MRSPTU, Bathinda
5. Principal/Director, Chandigarh University, Mohali.
6. Principal/Director, Asra College of Engineering & Technology, Bhawanigarh.
7. Concerned student through college/Department

ਮਹਾਰਾਜਾ ਰਣਜੀਤ ਸਿੰਘ ਪੰਜਾਬ ਤਕਨੀਕੀ ਯੂਨੀਵਰਸਿਟੀ, ਬਠਿੰਡਾ
ਡੱਬਵਾਲੀ ਰੋਡ, ਬਠਿੰਡਾ - 151001
Maharaja Ranjit Singh Punjab Technical University
DABWALI ROAD, BATHINDA-151001
[A State University Estb. by Govt. of Punjab Act No. 5(2015) u/s 2(f) & Approved u/s 12B of UGC Act, 1956]
ਐਸੋ. ਡੀਨ (ਅਕਾਦਮਿਕ ਮਾਮਲੇ)
Associate Dean (Academic Affairs)

Ref. No.: DAA/MRSPTU/2023/ 4297

Date: 18/09/2023

MIGRATION ORDER

(Intra-University)

In response to the student's request for intra-university migration and the NoC issued by Nirman Campus of Education, Research & Training, Sunam and the college of choice, the University is pleased to grant the migration as a special case for the following student in accordance with the migration regulation 2016.

Sr.No.	Name	Roll No.	Branch	Sem.	From	To
1.	Vansh Jindal	220232281	BCA	3rd	Nirman Campus of Education, Research & Training, Sunam	KCT College of Engg. & Tech., Fatehgarh

The approval has been given subject to the following conditions.

1) The Student will deposit the Semester fee, Examination fee or any other fee as per the norms of MRSPTU, Bathinda, within 7 days of issue of this letter.
2) The student is required to deposit the 3rd semester fee in the new Institute. If already deposited with the previous institute then the institute shall transfer the fee to the new institution within 15 days.
3) The university roll no. of the student shall remain unchanged.
4) The student can be taken on its rolls by the new college only after satisfying the above conditions.
5) The institute must ensure that extra classes be arranged to full-fill the attendance requirement
6) The receiving college HoD must confirm the date of reporting of the student to all concerned.

Associate Dean (Academic Affairs),
MRSPTU, BATHINDA

Copy to:

1. PA to Hon'ble Vice Chancellor, MRSPTU, Bathinda, for kind information please
2. Controller of Examinations, MRSPTU, Bathinda
3. Prof. I/C Finance, MRSPTU, Bathinda
4. Director/Principal, Nirman Campus of Education, Research & Training, Sunam.
5. Director/Principal, KCT College of Engg. & Tech., Fatehgarh
6. Concerned student through email