Maharaja Ranjit Singh Punjab Technical University
Bathinda-151001

FACULTY OF SCIENCES

SYLLABUS

FOR

INTEGRATED/DUAL DEGREE B.SC.-M.SC. (FORENSIC SCIENCE)

2023 BATCH ONWARDS

MRSPTU INTEGRATED/DUAL DEGREE B.SC.-M.SC. (FORENSIC SCIENCE) SYLLABUS 2023 BATCH ONWARDS

SCHEME

1st Semester		Contact Hrs.			Marks			Credits
Subject Code	Subject	L	T	P	Int.	Ext	Total	
BHSMC0-042	English	2	0	0	40	60	100	2
BMFSS1-101	General Forensic Science and Criminal Law	3	0	0	40	60	100	3
BMFSS1-102	Elements of Questioned Document Examination	3	0	0	40	60	100	3
BSNMS1-103	Inorganic Chemistry-I	3	0	0	40	60	100	3
BSNMS1-104	Organic Chemistry-I	3	0	0	40	60	100	3
BSNMS1-108	Chemistry Lab- I	0	0	4	60	40	100	2
Group - I								
BMFSS1-103	Biodiversity (Microbes, Algae, Fungi &Archegoniate)	4	0	0	40	60	100	4
BMFSS1-104	Botany Lab. I	0	0	4	60	40	100	2
BMFSS1-105	Diversity of Animals-I	4	0	0	40	60	100	4
BMFSS1-106	Zoology Lab. I	0	0	4	60	40	100	2
Group - II								
BSNMS1-105	Differential Calculus-I	3	0	0	40	60	100	3
BSNMS1-106	Differential Calculus-II	3	0	0	40	60	100	3
BSNMS1-102	Mechanics	4	0	0	40	60	100	4
BSNMS1-107	Mechanics Lab	0	0	4	60	40	100	2
Total		**22/24**	**0**	**12/8**	**460/440**	**540/560**	**1000**	**28**

Type of Courses: Ability Enhancement Compulsory Course (AECC), Core Course (CC), Skill Enhancement Course (SEC), Discipline Specific Elective (DSE)
* Students can choose group of subjects among Group I and Group II.
Note: Exit policy is available as per UGC norms

2nd Semester		Contact Hrs.			Marks			Credits
Subject Code	Subject	L	T	P	Int.	Ext	Total	
BMNCC0-041	Drug abuse: problem, management and prevention	2	0	0	100	00	100	0
BSNMS1-203	Physical Chemistry-I	3	0	0	40	60	100	3
BSNMS1-204	Organic Chemistry-II	3	0	0	40	60	100	3
BMFSS1-201	Fingerprints Examination and Forensic Photography	3	0	0	40	60	100	3
BMFSS1-202	Questioned Document and Fingerprint Laboratory	0	0	2	60	40	100	1
BSNMS1-208	Chemistry Lab-II	0	0	4	60	40	100	2
Group - I								
BMFSS1-203	Plant Ecology &Taxonomy	4	0	0	40	60	100	4
BMFSS1-204	Botany Lab. II	0	0	4	60	40	100	2
BMFSS1-205	Diversity of Animals-II	4	0	0	40	60	100	4
BMFSS1-206	Zoology Lab. II	0	0	4	60	40	100	2
Group - II								
BSNMS1-202	Electricity, Magnetism and EMT	4	0	0	40	60	100	4
BSNMS1-205	Differential Equations-I	3	0	0	40	60	100	3
BSNMS1-206	Differential Equations-II	3	0	0	40	60	100	3
BSNMS1-207	Electricity, Magnetism and EMT Lab	0	0	4	60	40	100	2
Total		**19/21**	**0**	**14/10**	**540/520**	**460/480**	**1000**	**24**

3rd Semester		Contact Hrs.			Marks			Credits
Subject Code	Subject	L	T	P	Int.	Ext	Total	
BSNMS1-303	Inorganic Chemistry-II	3	0	0	40	60	100	3
BSNMS1-304	Physical Chemistry-II	3	0	0	40	60	100	3
BMFSS1-301	Criminalistics	3	0	0	40	60	100	3
BMFSS1-302	Criminalistics Laboratory	0	0	2	60	40	100	1
BSNMS1-305	Chemistry Lab III	0	0	4	60	40	100	2
Group - I								
BMFSS1-303	Plant Anatomy &Embryology	4	0	0	40	60	100	4
BMFSS1-304	Botany Lab. III	0	0	4	60	40	100	2
BMFSS1-305	Physiology & Biochemistry	4	0	0	40	60	100	4
BMFSS1-306	Zoology Lab. III	0	0	4	60	40	100	2
Group - II								
BSNMS1-306	Real Analysis-I	3	0	0	40	60	100	3
BSNMS1-307	Real Analysis-II	3	0	0	40	60	100	3
BSNMS1-301	Thermal Physics and Statistical Mechanics	4	0	0	40	60	100	4
BSNMS1-302	Thermal Physics and Statistical Mechanics Lab	0	0	4	60	40	100	2
Total		**17/19**	**0**	**14/10**	**440/420**	**460/480**	**900**	**24**

4th Semester		Contact Hrs.			Marks			Credits
Subject Code	Subject	L	T	P	Int.	Ext	Total	
BHSMC0-041	Environmental Science	3	0	0	40	60	100	3
BSNMS1-403	Organic Chemistry-III	3	0	0	40	60	100	3
BSNMS1-404	Physical Chemistry-III	3	0	0	40	60	100	3
BSNMS1-405	Chemistry Lab-IV	0	0	4	60	40	100	2
BMFSS1-401	Forensic Psychology	3	0	0	60	40	100	3
Group - I								
BMFSS1-402	Plant Physiology &Metabolism	4	0	0	40	60	100	4
BMFSS1-403	Botany Lab. IV	0	0	4	60	40	100	2
BMFSS1-404	Genetics &Evolutionary Biology	4	0	0	40	60	100	4
BMFSS1-405	Zoology Lab. IV	0	0	4	60	40	100	2
Group - II								
BSNMS1-401	Waves and Optics	4	0	0	40	60	100	4
BSNMS1-402	Waves and Optics Lab	0	0	4	60	40	100	2
BSNMS1-406	Algebra-I	3	0	0	40	60	100	3
BSNMS1-407	Algebra-II	3	0	0	40	60	100	3
Total		**20/22**	**0**	**12/8**	**440/420**	**460/480**	**900**	**26**

5th Semester		Contact Hrs.			Marks			Credits
Subject Code	Subject	L	T	P	Int.	Ext	Total	
BSNMD1-521	Chemistry of Main group elements	4	0	0	40	60	100	4
BSNMD1-522	Chemistry of Main group elements Lab	0	0	4	60	40	100	2
BMFSS1-501	Fundamentals of Computer Forensics	3	0	0	40	60	100	3
BMFSS1-502	Computer Forensics Laboratory	0	0	2	60	40	100	1
Group - I								
BMFSS1-503	Botany-I Cell and Molecular Biology	4	0	0	40	60	100	4
BMFSS1-504	Botany Lab. V	0	0	4	60	40	100	2
BMFSS1-505	Comparative Anatomy & Vertebrates	4	0	0	40	60	100	4
BMFSS1-506	Zoology Lab. V	0	0	4	60	40	100	2
Group - II								
BSNMD1-531	Matrices	3	0	0	40	60	100	3
BSNMD1-532	Linear Algebra	3	0	0	40	60	100	3
BSNMD1-511	Digital Analog and Instrumentation	4	0	0	40	60	100	4
BSNMD1-512	Digital Analog and Instrumentation Lab	0	0	4	60	40	100	2
Total		15/17	0	14/10	400/380	400/420	800	22

6th Semester		Contact Hrs.			Marks			Credits
Subject Code	Subject	L	T	P	Int.	Ext	Total	
BSNMD1-621	Comprehensive Chemistry	4	0	0	40	60	100	4
BSNMD1-622	Comprehensive Chemistry Lab	0	0	4	60	40	100	2
BMFSS1-601	Forensic Audio Video Examination	3	0	0	40	60	100	3
BMFSS1-602	Forensic Audio Video Examination Laboratory	0	0	2	60	40	100	1
Group - I								
BMFSS1-603	Economic Botany and Biotechnology	4	0	0	40	60	100	4
BMFSS1-604	Developmental Biology	0	0	4	40	60	100	2
BMFSS1-605	Botany Lab. VI	4	0	0	60	40	100	4
BMFSS1-606	Zoology Lab.VI	0	0	4	60	40	100	2
Group - II								
BSNMD1-611	Elements of Modern Physics	4	0	0	40	60	100	4
BSNMD1-612	Elements of Modern Physics Lab	0	0	4	60	40	100	2
BSNMD1-631	Numerical Methods	3	0	0	40	60	100	3
BSNMD1-632	Complex Analysis	3	0	0	40	60	100	3
Total		15/17	0	14/10	400/380	400/420	800	22

FIRST SEMESTER

ENGLISH

Subject Code: BHSMC0-042   **L T P C**   **Duration:30 Hrs.**
                                      2 0 0 2

Course Objective: To improve the communication skills of students.
Course Outcome: To make student capable for attending interviews and for presenting their research in conferences.

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.

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 Etiquette for Success', 5th Edition, 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. Francis Peters S.J., 'Soft Skills and Professional Communication', 1st Edition, McGraw Hill Education, 2011.
10. John A., 'Effective Communication', 4th Edition, Pan MacMillan, 2009.
11. Aubrey D., 'Bringing out the Best in People', 2nd Edition, McGraw Hill, 1999.

Subject Code: BMFSS1-101   **L T P C**   **Duration: 45Hrs.**
                                                          3 0 0 3

Course Objective:
1. To familiarize with history of Forensic Science.
2. To understand the importance of Forensic Science
3. To understand the working of Forensic Science labs and Police administration in India.
4. To understand various criminal laws and its importance in Forensic Science.

Course Outcome (CO): After the completion of the course, student will be able to:
CO1: Understand the concept of Forensic Science.
CO2: Learn the present scenario of Forensic Science in India and its scope
CO3: Gain knowledge about the various types of crimes.
CO4: Understand Criminal Law.

UNIT-I (15 Hrs)

Basic concepts of Forensic Science-I: Definition of Forensic Science by different authors, History of Forensic Science, Seven principles of Forensic Science, Nature, need, scope and functions of Forensic Science, Tools and techniques in forensic science, Ethics in Forensic Science, Subjective and objective observation, Qualitative and quantitative analysis, Preliminary and confirmatory tests, Positive control, negative control and blank samples.
Basic concepts of Forensic Science-II:, Modus operandi and its role in crime records, Corpus delicti, Prima facie, Admissibility of scientific evidence in the courtroom, Frye and Daubert standards.

UNIT-II (10Hrs)

Forensic Science Laboratories in India: Forensic science laboratories (FSLs) in India and its types- Central, State, Regional and Mobile FSLs, Branches of FSLs, Setup of FSLs, Hierarchy of experts in Forensic Science Laboratories, Services provided by FSLs, Functioning of FSLs, roles and responsibilities of forensic scientist, the Laboratory Information Management System(LIMS).
Report writing and Court testimony: FIR, Report writing and evidence evaluation, Components of report, Report format in respect of crime scene and laboratory findings, Court trial and testimony, Pre- Court Preparation and Court appearance

UNIT-III (13Hrs)

Criminal Law:
Definitions: Actus rues, Mens rea and its types, Bailable/non-bailable offences, Cognizable/non-cognizable, Summon cases and warrant cases.
Special Forms of Crime: Organized Crime: Gangs/Criminal Networks, Socio-Economic Crime, Custodial Crime, White-Collar Crime, Crime against Women/Children, Sex Offences. Correctional Therapy: Probation, Parole, Furlough, Remission and Pardon
Code of Criminal Procedure (CrPC): Sections- 291,292,293.
Indian Evidence Act (IEA): Sections-32, 45, 46, 47, 57, 58, 60, 73, 135,136, 137, 138,141.
Indian Penal Code (IPC): Sections (Offences against the person) -299,300,302,304B, 307, 309, 319, 320,324,326,351,354,359,362,375,376,377 and Sections (Offences against property)-378, 383,390,391,420, 463, 497,499, 503and 511.

UNIT-IV (07 Hrs)

Indian Constitution: Article 20 and 21.

Recent amendments in above mentioned sections of all laws.

Police Administration: History and development of police administration, Duties, roles, responsibilities and power of Police, Organizational structure of police, Relationship between police and forensic scientist with respect to crime investigation

People and society: Custodial deaths, Police and Human Rights.

Recommended Books:

1. Siegel J. A. and Mirakovits K: Forensic Science: The Basics, CRC Press, 3rd Edition, 2016.
2. Siegel J. A. and Saukko P. J.: Encyclopedia of Forensic Sciences, Academic Press, 2ndEdition, 2013.
3. Saferstein R: Forensic Science Hand Book, Vol I, CRC Press, 3rd Edition.2020.
4. Saferstein R: Forensic Science Hand Book, Vol II, Pearson, 2nd Edition.2005.
5. Saferstein R: Forensic Science Hand Book, Vol III, Pearson, 2nd Edition.2010.
6. Saferstein, R: Criminalistics: An Introduction to Forensic Science, Pearson, 12thEdition, 2018.
7. Sharma B.R.: Forensic Science in Criminal Investigation & Trials, Universal Law Publishing, 6thEdition, 2020.
8. The Constitution of India by Legislative Department, Ministry of Law and Justice, Govt. of India.
9. TheIndianEvidenceAct,1872 by Legislative Department, Ministry of Law and Justice, Govt. of India.

<div style="background-color:gold">**ELEMENTS OF QUESTIONED DOCUMENT EXAMINATION**</div>

Subject Code: BMFSS1-102	**L T P C** **3 0 0 3**	**Duration: 45Hrs.**

Course Objectives:
1. To understand the importance of Questioned Document as an evidence.
2. To understand the principles of handwriting.
3. To acquire the knowledge of comparison of type written and printed matter.
4. To acquire knowledge of Standards for comparison.

Course Outcome (CO): After the completion of the course, student will be able to:
CO1: Understand the concept of Questioned Documents.
CO2: Gain knowledge regarding forgery, its type and examination.
CO3: Gain knowledge of cases which fall under purview of digital crimes.
CO4: Understand the elements involved in investigation of digital crimes.

UNIT-I (15 Hrs)

Documents in general: Importance, Classification and Preliminary Examination. **Elements of Handwriting:** Elements of Execution and Style Development of Individuality in Handwriting and Principles of handwriting identification.

UNIT-II (10Hrs)

Natural Variations in handwriting: Definition and nature, Determination of range of variations (consistency) and its importance. **Fundamental divergence sin handwriting:** Its interpretation in relation to identification of handwriting, consideration of various writing instruments used in writing.

UNIT-III (12Hrs)

Standards for comparison: Requested and Collected Standards **Alterations in the document:** Erasures, Additions, Overwriting and Obliterations: their examination **Forgery:** Definitions, types and characteristics **Disguise:** Definition and Characteristics **Indented and Invisible Writings:** Introduction and Methods of examination.

UNIT-IV (08Hrs)

Comparison of typewritten and Printed matter: Working and Types, Printing and Machine Defects, alterations in Printed and typed text. Photostat Machines and Fax machines: Examination of printouts from them. Working and Principle of Projectina /video- spectral comparator (VSC), ESDA, Docucenter Examination of Currency. Comparison of digitally manipulated documents.

Recommended Books:
1. Huber, A. R. and Headrike, A.M. (1999), Handwriting identification: facts and fundamental, CRC LLC.
2. Ellen, D (Edition 2nd) (1997), The scientific examination of Documents, Methods and techniques, Taylor & Francis Ltd.
3. Morris (Edition 1st) (2000), Forensic Handwriting Identification (fundamental concepts and Principals), Academic Press Inc.
4. Harrison, W.R (1966), Suspect Documents & their Scientific Examination, Sweet & Maxwell Ltd., London.
5. Hilton, O (1982), The Scientific Examination of Questioned Document, Elsevier North Holland Inc., New York.
6. Sulner, H.F. (1966), Disputed Document, Oceana Publications Inc., New York.

7. Saxena B.L. (1968), Saxena's Law & Techniques Relating to Finger Prints, Foot Prints & Detection of Forgery, Central Law Agency, Allahabad (Ed. A.K. Singla).

8. Quirke, A.J. (1930), Forged, Anonymous &Suspet Documents, ReorgeRontledge& Sons Ltd., London.

9. Osborn, A. S. (1929), Questioned Documents, Boyd Printing Co., Chicago.

10. Levinson, J (2000), Questioned Documents, Academic Press, Tokyo.

11. Kelly, J.S and Lindblom, B.S (2006), Scientific Examination of Questioned Documents, Taylor & Francis, New York.

12. Brunelle, R.L. and Reed, R.W. (1984), Forensic Examination of Ink and Paper, Charles C Thomas Publisher, U.S.A.

13. Baker, J.N. (1955), Law of Disputed and Forged Documents, The Michie Company, Virginia

INORGANIC CHEMISTRY-I

Subject Code: BSNMS1-103   **L T P C**   **Duration: 45Hrs.**
                                      3 0 0 3

Course Objectives
1. To familiarize with atomic structure, quantum numbers and shapes of orbitals
2. To understand periodic table and periodic properties of elements
3. To understand the concept of crystal structure of molecules
4. To understand the concept of various bonding theories

Course Outcomes: The completion of this course will make student to acquire the knowledge of:
CO1: Wave mechanics, atomic theories and shapes of orbitals
CO2: Periodic table and various periodic properties
CO3: Ionic bond and crystal structure of molecules
CO4: Covalent bond, metallic bond and various weak chemical forces

UNIT-I (8 Hrs.)
Atomic Structure:
De-Broglie equation, Heisenberg's Uncertainty Principle and its significance. Schrödinger's wave equation and its derivation, significance of ψ and $\psi2$. Quantum numbers. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions and distribution curves. Shapes of s, p, d and f orbitals.
Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau principle and its limitations.

UNIT-II (7 Hrs.)
Chemical Periodicity:
Effective nuclear charge, shielding or screening effect (Slater rules), variation of effective nuclear charge in periodic table.
Atomic and ionic radii, Ionization enthalpy, Electron gain enthalpy and their trend in groups and periods.
Electronegativity and various scales. Variation of electronegativity with bond order, partial charge, hybridization, group electro negativity.

UNIT-III (15 Hrs.)
Chemical Bonding-I:
Ionic bond: General characteristics of ionic compounds, size effects, radius ratio rule and its limitations. Efficiency of packing, Hexagonal close packing, Cubic close packing. Structures of different crystal lattices: Sodium chloride, Cesium chloride, Wurtzite, Zinc blende, Fluorite, Rutile, Cristobalite, Nickel arsenide, Pervoskite, Rhenium oxide, Calcium carbide, The calcite and aragonite structures.
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 (15 Hrs.)
Chemical Bonding-II:
Covalent bond: Lewis structure, Valence Bond theory, VSEPR theory (Prediction of structures and variation of bond angles on the basis of VSEPR theory, Shortcomings of VSEPR theory), Hybridization, Molecular orbital theory (LCAO method). Molecular orbital diagrams of diatomic and simple polyatomic molecules ($Be2$, $N2$, $O2$, $F2$, LiH, NO, CO, HCl, $NO2$,

BeH_2, NO_2^-), Formal charge, Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds (Bond moment, dipole moment, Percentage ionic character)

Metallic Bond: Valence bond and band theories. Semiconductors and insulators, defects in solids. Weak Interactions: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interaction, Hydrogen bonding.

Recommended Books:

Latest edition of:

1. D.F.C. Shriver, P.W. Atkins and C.H. Langford, 'Inorganic Chemistry', ELBS Oxford.
2. J.E. Huheey, E.A. Keiter, R.L. Keiter, 'Inorganic Chemistry',Pearson Education, Singapore.
3. J.D. Lee, 'Concise Inorganic Chemistry', ELBS, Oxford.

ORGANIC CHEMISTRY-I

Subject Code: BSNMS1-104   **L T P C**   **Duration: 45Hrs.**

                                             3 0 0 3

Course Objectives:
1. To familiarize with the concepts of basics of organic chemistry
2. To understand the concept of mechanisms of organic reactions
3. To familiarize with the chemistry of alkanes and cycloalkanes
4. To understand chemistry of alkenes and alkynes
5. To know the chemistry behind aromatic hydrocarbons

Course outcomes: After the completion of course students will acquire the knowledge of:
CO1: Concepts of basics of structure and bonding
CO2: Mechanisms of organic reactions
CO3: Chemistry of aliphatic hydrocarbons
CO4: Chemistry behind aromatic hydrocarbons

UNIT-I (15 Hrs.)

Structure and Bonding:
Hybridization, bond lengths, bond angles, bond energy, localized and delocalized chemical bond, van der Waals interactions, inclusion compounds, clatherates, charge transfer complexes, resonance, hyperconjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions:
Curved arrow notation, drawing electron movements with arrows, half-headed and double-headed arrows, homolytic and heterolytic bond breaking. Types of reagents- electrophiles and nucleophiles. Types of organic reactions. Energy considerations. Reactive intermediates (carbocations, carbanions, free radicals, carbenes, arynes and nitrenes). Assigning formal charges on intermediates and other ionic species.
Methods of determination of reaction mechanism (product analysis, intermediates, isotope effects, kinetic and stereo chemical studies).

UNIT-II (10 Hrs.)

Alkanes and Cycloalkanes:
Introduction, IUPAC nomenclature, Isomerism and classification of carbon atoms of alkanes. Sources, methods of formation (with special reference to Wurtz reaction, Kolbe reaction, Corey- House reaction and decarboxylation of carboxylic acids). Physical properties and chemical reactions of alkanes.
Mechanism of free radical halogenation of alkanes: orientation, reactivity and selectivity. Cycloalkanes - nomenclature, methods of formation, chemical reactions, Baeyer's strain theory and its limitations. Ring strain in small rings (cyclopropane and cyclobutane), theory of strainless rings. The case of cyclopropane ring; banana bonds.

UNIT-III (14 Hrs.)

Alkenes, Cycloalkenes, Dienes and Alkynes:
Alkenes Nomenclature, methods of synthesis (mechanisms of dehydration of alcohols and dehydrohalogenation of alkyl halides, regioselectivity in alcohol dehydration. Saytzeff rule, Hofmann elimination), physical properties and relative stabilities of alkenes. Chemical reactions of alkenes - mechanisms involved in hydrogenation, electrophilic and free radical additions, Markownikoff's rule, hydroboration-oxidation, oxymercuration-reduction. Epoxidation, ozonolysis, hydration, hydroxylation and oxidation with $KMnO_4$, Polymerization of alkenes. Substitution at the allylic and vinylic positions of alkenes. Industrial applications of ethylene and propene.

Cycloalkenes Methods of formation, conformation and Chemical reactions of cycloalkenes.
Dienes Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes.
Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions
– 1, 2 and 1,4 additions, Diels-Alder reaction.
Alkynes Nomenclature, structure and bonding in alkynes. Methods of formation. Chemical
reactions of alkynes, acidity of alkynes. Mechanism of electrophilic and nucleophilic addition
reactions, hydroboration oxidation, metal-ammonia reductions, oxidation and polymerization.

UNIT-IV (6 Hrs.)

Aromatic hydrocarbons:
Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene
sulphonic acid.
Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and
sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).
Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Recommended Books:
Latest edition of:
1. Morrison and Boyd, 'Organic Chemistry', Prentice Hall.
2. Solomons, 'Fundamentals of Organic Chemistry', JohnWiley.
3. F.A. Carey, 'Organic Chemistry', McGraw Hill,Inc.
4. L.G. Wade Jr., 'Organic Chemistry', Prentice Hall.
5. S.M. Mukherji, S.P. Singh and R.P. Kapoor, 'Organic Chemistry', Vol.-I, II & III, Wiley
   Eastern Ltd. (New Age International).

CHEMISTRY LAB- I

Subject Code: BSNMS1-108	**L T P C**	**Duration: 60Hrs.**
	0 0 4 2	

Course Objectives:
 1. To develop basic understanding of various lab practices including safety measures.
 2. To understand qualitative semi micro analysis of mixtures.
 3. To analyze unknown functional group in organic molecules.
 4. To understand various chromatographic techniques used for separation of dyes.

Course Outcomes: The students will acquire knowledge of
CO1: Different safety measures in lab
CO2: Analysis of mixture for cations and anions
CO3: Analysis of unknown functional group in organic molecules
CO4: chromatographic techniques used for separation of dyes

Inorganic Chemistry:
Semi Micro analysis. Cation analysis, Separation and identification of ions from groups I, II, III, IV, V, and VI. Anionic analysis. Four ions with no interference.

Organic Chemistry Laboratory Techniques:
Detection of various functional groups in organic compounds (containing upto two extra elements)

Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
Identify and separate the components of a given mixture of two dyes (red and blue ink, fluorescent and methylene blue) by paper chromatography

Recommended Books:
Latest edition of:
 1. H. Denny, W. Roesky, 'Chemical Curiosites', WILEY VCH.
 2. G. Marr and B.W. Rocket,'Practical Inorganic Chemistry', University Science Books.
 3. G. Pass and H. Sutcliffe, 'Practical Inorganic Chemistry', Chapman and Hall, London.
 4. J. Mendham, R.C. Denney, J.D. Barnes, M.Thomas, 'Vogel's Textbook of Quantitative Analysis',Pearson Education.
 5. G. Svehla, 'Vogel's Textbook of Quantitative Analysis', Pearson Education.

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GROUP-1

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BIODIVERSITY (MICROBES, ALGAE, FUNGI &ARCHEGONIATE)

Subject Code: BMFSS1-103   **L T P C**   **Duration: 60Hrs.**
                                      4 0 0 4

Course Objectives:
1. To ensure students can achieve an up-to-date level of understanding of biodiversity of microbes, algae, fungi and archegoniate.
2. To provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.
3. To provide knowledge of latest published findings.

Course Outcomes (CO): The completion of the course will make student to acquire the knowledge of:
CO1: Microbes, algae, Fungi.
CO2: Archegoniate, Bryophytes.
CO3: Pteridophytes and Gymnosperms.

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UNIT-I (15 Hours)

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Microbes: Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria– Discovery,Generalcharacteristicsandcellstructure;Reproduction–vegetative,   asexual   and recombination (conjugation, transformation and transduction);Economic importance.
Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Economic importance of algae

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UNIT-II (15 Hours)

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Fungi: Introduction- General characteristics, ecology and significance, range of thallusorganization,cellwallcomposition,nutrition,reproductionandclassification;TrueFungi-Generalcharacteristics,ecologyandsignificance,lifecycleofRhizopus(Zygomycota),Puccinia,Agaricus(Basidiomycota);SymbioticAssociations-
Lichens: Generalaccount,reproductionandsignificance;Mycorrhiza:ectomycorrhizaandendomycorrhiza and their significance, Fungi like organisms Albugo, Phytophthora and slime molds

<div align="center">

UNIT-III (15 Hours)

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Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations
Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (upto family), morphology, anatomy andre production of Marchantia and Funaria. (Developmental details not to be included).Ecology and economic importance of bryophytes with special mention of Sphagnum.

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UNIT-IV (15 Hours)

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Pteridophytes: General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (uptofamily), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.
Gymnosperms: General characteristics, classification. Classification (upto family), morphology, anatomy and reproduction of Cycas and Pinus. (Developmental details not to be included). Ecological and economical importance.

Recommended Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi.2ndedition.
2. Tortora, G.J., Funke,B.R., Case, C.L. (2010). Microbiology:An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi,I.K.andWalia,S.K.(2011).TextbookofFungi&TheirAllies,MacMillanPublishersPvt.Ltd., Delhi.
4. B.R.Vashishta,(2016) Botany For Degree Students Fungi.S Chand &Company.
5. Geeta Sumbali,(2011)The Fungi. Alpha science Intl Ltd Second Edition.
6. KRAneja&RSMehrotra(2015)AnIntroductiontoMycology.NewAgeInternationalPublishers Second Edition.

BOTANY LAB-1

Subject Code: BMFSS1-104 | **L T P C**
 0 0 4 2 | **Duration: 60Hrs.**

Course Objectives:
1. To understand basic understanding of lab practices including safety measures.
2. To analyse the vegetative and reproductive structures of Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus.
3. To analyse the type of bacteria from slides.

Course Outcomes (CO): The completion of the practical will make student to acquire the knowledge of:
CO1: Different Safety measures in lab.
CO2: Analysis of the vegetative and reproductive structures.
CO3: Analysis of Pteridophytes and Gymnosperms

1. EMs/Models of viruses– T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron Micrographs), Oedogonium, Vaucheria, Fucus*and Polysiphonia through permanent slides.
5. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. Alternaria: Specimens/photographs   and   tease   mounts.
7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and in fected Barberry leaves
8. Agaricus: Specimens of button stage and full grown mushroom
9. Lichens: Study of growth forms of lichens(crustose, foliose and fruticose)
10. Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs)
11. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemmacup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing anther dial and archegonialheads, l.s. capsule and protonema.
13. Selaginella-morphology, w.m. leafwithligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. Equisetum-morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry) (temporary slides); t. srhizome (permanent slide).
15. Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. Pinus- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. malecone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. femalecone, t.l.s. & r.l.s. stem (permanent slide).

Recommended Books:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi.2ndedition.
2. Tortora, G.J., Funke,B.R., Case, C.L. (2010).Microbiology: An Introduction,PearsonBenjaminCummings, U.S.A. 10th edition.
3. Sethi,I.K.andWalia,S.K.(2011).TextbookofFungi&TheirAllies,MacMillanPublishersPvt. Ltd., Delhi.
4. B.R.Vashishta,(2016) BotanyForDegreeStudentsFungi.S Chand&Company.
5. GeetaSumbali,(2011)TheFungi.Alphascience IntlLtdSecondEdition.
6. KRAneja&RSMehrotra(2015)AnIntroductiontoMycology.NewAgeInternationalPublishers Second Edition.

DIVERSITY OF ANIMALS-1

Subject Code: BMFSS1-105   **L T P C**   **Duration: 60Hrs.**
                                 4 0 0 4

Course Objectives:
1. To ensure students can achieve an up-to-date level of understanding of biodiversity of animals.
2. To provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.
3. To provide knowledge of latest published findings.

Course Outcomes (CO): The completion of the course will make student to acquire the knowledge of:
CO1: Kingdom Protista
CO2: Importance of Arthropodain in Forensic Sciences.
CO3: Importance of knowledge of Diversity of Animals in Forensic Science.

UNIT-I (15 Hours)

Kingdom Protista
General characters and classification upto classes; Locomotory Organelles and locomotion in Protozoa-Ameoba, Paramecium, Euglena

UNIT-II (15 Hours)

Phylum Porifera
General characters and classification up to classes; Canal Systemin Sycon
Phylum Cnidaria
General characters and classification up to classes; Polymorphismin Hydrozoa, coral & coral reefs

UNIT-III (15Hours)

Phylum Platyhelminthes
General characters and classification up to classes; Life history of Taeniasolium and Fasciola Hepatica
Phylum Ashelminthes
General characters and classification up to class, Life Cycle of Ascaris, Parasitic adaptation in Helminthes
Phylum Annelida
General characters and classification up to classes; Metamerism in Annelida

UNIT-IV (15 Hours)

Phylum Arthropoda
General characters and classification upto classes; Vision in Arthropoda, MetamorphosisinInsects, Importance of Arthropoda in Forensic Sciences
Phylum Mollusca
General characters and classification upto classes; Torsioningastropods

Recommended Books:
1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002).
3. Invertebrates: A New Synthesis, III Edition, Blackwell Science Young, J. Z. (2004).
4. The Life of Vertebrates. III Edition. Oxford university press.
5. Pough H. Vertebrate life, VIII Edition, Pearson International.
6. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

ZOOLOGY LAB-1

Subject Code: BMFSS1-106 **L T P C** **Duration: 60Hrs.**
0 0 4 2

Course Objectives

1. To understand basic understanding of lab practices including safety measures.
2. To analyse pond water collected from different places.
3. To analyze the Obelia, Physalia, Millepora etc.

Course Outcomes (CO): The completion of the practical will make student to acquire the knowledge of:

CO1: Different Safety measures in lab.
CO2: Analysis of the Ascarislumbricoides and its life stages (Slides/micro-photographs)
CO3: Analysis of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla

Experiments:

1. StudyofwholemountofEuglena,AmoebaandParamecium,BinaryfissionandConjugatio nin Paramecium
2. Examination of pond water collected from different places for diversity in protista
3. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla
4. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora
5. Onespecimen/ slide of anyctenophore
6. Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/ microphotographs)
7. Study of adult Ascarislumbricoides and its life stages (Slides/micro-photographs)
8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.

Recommended Books:

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Black well Science
3. Young, J.Z.(2004).The Life of Vertebrates. III Edition. Oxford university press.
4. Pough H. Vertebrate life, VIII Edition, Pearson International.
5. HallB.K.andHallgrimssonB.(2008).Strickberger'sEvolution.IVEdition.JonesandBartl ettPublishersInc.

GROUP-2

DIFFERENTIAL CALCULUS-I

Subject Code: BSNMS1-105	L T P C	Duration: 45 Hrs.
	3 0 0 3	

Course Objectives:
1. To ensure students can achieve an up-to-date level of understanding of differential calculus.
2. To provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.
3. To provide knowledge of latest published findings.

Course Outcomes:
1. Understand the concept of Continuity and Differentiability.
2. Extend the knowledge to the different type of series, Roll's Theorem and Lagrange Mean Value Theorem
3. Develop the skill to sketch the curves in a plane using its mathematical properties in the different coordinate systems of reference.
4. Understand the concept of Partial Differential Equation.

UNIT-I (12Hrs.)

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem.

UNIT-II (11Hrs.)

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, ex , $\log(1+x)$, $(1+x)^m$, Maxima and Minima, Indeterminate forms.

UNIT-III (14 Hrs.)

Tangents and normals, Curvature, Asymptotes, Singular points, Tracing of curves. Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates.

UNIT-IV (8 Hrs.)

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.

Recommended Books:
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, Prentice Hall 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.

DIFFERENTIAL CALCULUS-II

Subject Code: BSNMS1-106   **L T P C**   **Duration: 45 Hrs.**
                                       3 0 0 3

Course Objectives:
1. To ensure students can achieve an up-to-date level of understanding of Differential Calculus.
2. To provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.
3. To provide knowledge of latest published findings.

Course Outcomes:
1. Apply the knowledge of advanced concepts of calculus in order to study theoretical development of different mathematical techniques and their applications.
2. Develop the knowledge of computing arc length, area and volume by using integration.
3. Understand the concept of integration and different kind of functions.
4. Expand the knowledge of multiple integrals and vector surface integrals.

UNIT-I (12Hrs.)
Tangent plane and normal to a surface, Maxima and Minima of functions of two variables, Working rule to find the extreme values of a function $z=f(x\ y)$, Lagrange's method of undetermined multipliers.

UNIT-II (10Hrs.)
Arc formula for the Cartesian equation $y=f(x)$, other expressions for lengths of arcs, Areas under curves, Area formulas for parametric, Polar equation, Area of the closed curve, Volume and surfaces of revolution of curves.

UNIT-III (12Hrs.)
Integration by partial fractions, Integration of rational and irrational functions, Properties of definite integral, Reduction formulae for integrals of rational, Trigonometric, Exponential and Logarithmic function and of their combinations.

UNIT-IV (11Hrs.)
Double integrals (Cartesian), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: Areas and volumes, Centre of mass and gravity, Triple integrals (Cartesian), Simple applications involving cubes, Sphere and rectangular parallelepipeds.

Recommended Books:
1. G. B. Thomas, M. D. Weir, J. Hass: Thomas' Calculus (Twelfth Edition), Pearson Education.
2. Gorakh Prasad: Integral Calculus, Fourteenth Edition, Reprint 2007, Pothishala Private Limited, Allahabad.
3. Zafar Ahsan: Differential Equations and Their Applications, Second Edition, Prentice Hall 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

MECHANICS

Subject Code: BSNMS1-102   **L T P C**   **Duration: 60Hrs.**
                               4 0 0 4

Course Objectives:
1. To ensure students can achieve an up-to-date level of understanding of mechanics.
2. To provide training in scientific and transferable skills through modular lecture courses, research projects, written work, seminars and supervisions.
3. To provide knowledge of latest published findings.

Course Outcome (CO): After the completion of the course, student will be able to:
1. Understand the concepts of vector calculus and basic laws of motion
2. Gain the knowledge about gravitational motion, and global positioning system
3. Understand the concepts of harmonic oscillations.
4. Learn the concept of theory of Relativity.

UNIT-I (15Hrs)

Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy.
Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque, Conservation of angular momentum.

UNIT-II (15Hrs)

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

UNIT-III (15Hrs)

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. Elasticity: Hooke's law, Stress- strain diagram, Elastic moduli-Relation between elastic constants, Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants, Work done in stretching and work done in twisting a wire, Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion, Torsional pendulum, Determination of Rigidity modulus and moment of inertia, q, η and σ by Searles method.

UNIT-IV (15 Hrs)

Special Theory of Relativity: Concept of Inertial and non-inertial frames, Concept of ether, Constancy of speed of light, Michelson-Morley Experiment, Galilean transformation, Postulates of Special Theory of Relativity, Lorentz transformation, Length contraction. Time dilation, Relativistic addition of velocities.

Recommended Books:
1. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986.AddisonWesley
2. Mechanics Berkeley Physics course, volume.1: Charles Kittel, et. Al. 2007, Tata McGraw Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley.
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press.
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

MECHANICS LAB

Subject Code: BSNMS1-107   **L T P C**   **Duration: 60Hrs.**
                              0 0 4 2

Course Objectives:
1. To understand basic understanding of lab practices including safety measures.
2. To determine the modulus of elasticity.
3. To use basic measurement tools.

Course Outcomes (COs): After the completion of the course, Student will be able to
1. Use basic measurements tools like Vernier caliper, screw gauge etc.
2. Find the Moment of Inertia of a Flywheel.
3. Determine the Modulus of elasticity
4. Learn about motion of Bar Pendulum and Kater's Pendulum.

List of Experiments:
1. Measurements of length (or diameter) using Vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Fly wheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using Digital Timing Technique.
10. To study the Motion of a spring and calculate (a) Spring Constant (b) Value of g

Recommended Books:
1. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. Engineering Practical Physics, S.Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.