Name of faculty: Science	**Department:** Biotechnology
Program: M. Sc. Biotechnology	**Type:** Theory + Practical
Subject: DSC-1 Bioprocess Technology	**Semester:**7
Credit: 04 + 02	**Total learning hours:** 60
Course description: The objectives of this course are to provide students with the theory and practical experience of Bioprocess Technology which facilitate investigation of design, development and optimization of Biological processes at industrial level.	
Student learning outcome: ● Able to gain a basic idea of Bioprocess and its utility. ● Able to understand basics of mass transfer and kinetic studies. ● Able to understand the aim of online and offline control. ● To gain knowledge on various mass transfer processes. ● To obtain ideas on validation in bioprocess industries.	

UNIT-1: Unit Operations in Bioprocess Technology: (5h)

1.1 Introduction to sterilization in bioprocess industry

1.2 Equipment sterilization

1.3 Monitoring of sterilization

1.4 Sterility audit and automation

UNIT-2: Mass Transfer-1 (7h)

2.1 Gas-liquid mass transfer in cellular systems

2.2 Determination of Oxygen Transfer Rates (OTR)

2.3 Introduction to Heat Transfer

2.4 Fourier Law of Heat Conduction

Unit-3 Mass Transfer-2 (7h)

3.1 Molecular Diffusion in fluids

3.2 Mass Transfer Coefficient

3.3 Interphase Mass Transfer

3.4 Fick's Law

Unit-4: Convective Heat Transfer (8h)

4.1 Natural and Forced Convection

4.2 Heat Flux

4.3 Heat Exchange Equipment

4.4 Enthalpy balance in heat exchange equipment

Unit-5 : Instrument Control (9h)

5.1 Fundamentals of Process Control

5.2 Control loops

5.3 Additional forms of Control

5.4 Measurement Elements

Unit- 6 Mass Transfer Process (8h)
6.1 Extraction
6.2 Drying
6.3 Crystallization
6.4 Liquid-liquid and Liquid-Solid Equilibrium

Unit-7 Distillation (9h)
7.1 Vapor-Liquid Equilibrium
7.2 Rayleigh's equation
7.3 Flash Distillation
7.4 Differential Distillation

Unit-8 Validation in Bioprocess Industry (7h)
8.1 Introduction to Pharmaceutical Validation
8.2 Need for Validation and Occurrence of Validation
8.3 Validation Structure and Resources for Validation
8.4 Validation of System and Process

References and Textbooks:

- James, B. & Ollis David, F. (2010). Biochemical engineering fundamentals. Tata McGraw Hill. ISBN: 9780070701236, 0070701237
- Lydersen, B. K., D'Elia, N. A. & Nelson, K. L. (Eds.). (2010). Bioprocess engineering: systems, equipment and facilities. Wiley India Pvt. Ltd. ISBN-13: 9780471035442
- Stanbury, P. F. & Whitaker, A. (1984). Principles of Fermentation Technology. Pergamon Press. ISBN- 978-8181478085
- Vogel, H. C. & Todaro, C. M. (1996). Fermentation and biochemical engineering handbook: principles, process design and equipment. William Andrew. ISBN-978-0815514077
- Heat Transfer by K.A. Gavhane (2008). ISBN-819063617 19th Edition Nirali Publisher
- Mass Transfer by Treybal (2017) 3rd Edition, McGraw Hill Education ISBN1259029158

Practicals:

1. To determine the OTR.
2. Determination of thermal death point (TDP) and thermal death time (TDT) of microorganisms for design of a sterilizer.
3. To determine heat transfer coefficient in heat exchanger for co-current and counter current flow.

Name of faculty: Science	**Department:** Biotechnology
Program: M.Sc. Biotechnology	**Type:** Theory + Practical
Subject: DSC-2 Plant and Animal cell Culture	Semester: 7
Credit: 04 + 02	Total learning hours: 60

Course description:
The aim of the course is to provide theoretical and practical knowledge, required for dealing with plant and animal cell and tissue cultures *in-vitro* and to maintain and set plant and animal suspension cultures under in vitro conditions

Student learning outcome: After the completion of this course:

- Students will understanding the principles of cell culture techniques
- Students will learn biochemical, molecular aspect of eukaryotic system
- Student will learn principles of gene expression and protein production and transport for high level protein production in various organelles
- Students will be acquainted with modern gene editing techniques in the area of plant and animal sciences for human welfare
- Students will learn to make use of plants as bioreactors by transforming them with genes having improved medicinal valuable

Unit 1 Growth, development and signal transduction in plants (07 hours)
1.1 Plant tissue culture and its types
1.2 Signal transduction in plant development: Receptors and receptor like kinases
1.3 Role of Auxin, Gibberellic acid, Cytokinin, Ethylene and Abscisic Acid, their mechanism of action
1.4 Photoperiodism and Vernalization, Dormancy and methods of breaking seed dormancy

Unit 2: Plant Gene Expression and Regulation (09 hours)
2.1 Gene structure, expression and regulation in eukaryotes, *Arabidopsis* as a model crop in plant biology, Forward and Reverse Genetic Approaches
2.2 Types of plant promoters, enhancers, and reporter system
2.3 Deletion analysis and In-silico analysis of the promoter to find out cis-acting regulatory elements
2.4 Transcriptional gene silencing and RNA interference, Functional analysis of genes: Activation tagging: A tool for plant gene discovery;

Unit 3: Protein Targeting and Functional gene analysis (08 hours)
3.1 Principles and Transport Across Cell Membranes to various organelles
3.2 Chloroplast Genes Expression, Chloroplast Transformation
3.3 Genome editing: Application of CRISPR- Cas9/Cpf1 in crop improvement
3.4 Allele mining by Tilling and Ecotilling

Unit 4 Molecular Farming (06 hours)
4.1 Molecular Farming and its Applications
4.2 Biotransformation and its applications
4.3 Edible vaccine, Medicinally related proteins-antibodies (plantibodies),
4.4 The oleosin system-Hirudin and Insulin production

Unit 5 Basics of Animal Tissue Culture (07 hours)
5.1 Applications, Advantages & Limitations
5.2 Types of Tissue Culture
5.3 Basic Lab requirements of ATC & Media Reagents
5.4 Biology of Cultured Cells

Unit 6 Primary culture & Subculture (08 hours)
6.1 Initiation of primary cell culture & isolation of tissues
6.2 Types of primary Culture
6.3 Criteria of subculture
6.4 Subculture of monolayer cells & suspension cells

Unit 7 Cell Separation (08 hours)
7.1 Cell Density & Isopyknic Sedimentation
7.2 Cell size & Sedimentation velocity
7.3 Antibody based techniques
7.4 Fluorescence – activated cell sorting

Unit 8 Quantitation & Cryopreservation (07 hours)
8.1 Cell Counting methods
8.2 Cell Viability Assays
8.3 Principles of Cryopreservation
8.4 Vitrification

Reference and Textbooks:

- Bhojwani SS. 1983. *Plant Tissue Culture: Theory and Practice*. Elsevier.
- Buchanan B, Gruissen W & Jones R. 2000. *Biochemistry and Molecular Biology of Plants*. American Society of Plant Physiologists, USA.
- Lewin B. 2008. *Gene IX.* Peterson Publications/ Panima.
- Malacinski GM & Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd Ed. Jones & Bartlett Publ.
- Nelson DL & Cox MM. 2007. *Lehninger's Principles of Biochemistry*. WH Freeman & Co.
- Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene.* 6th Ed. Pearson Education.
- In vitro Cultivation of Animal Cells by Currell B C, Butterworth- Heinemann
- Animal Cell Culture & Technology by M Butler, Taylor & Francis Pub.
- Animal Cell Culture by John R W. Master, oxford University Press
- Ian R. Freshney, Culture of animal cells: a manual of basic technique and specialized applications, 6th Ed., Willey Blackwell pub.

Practicals

1. Preparation of Chu-N6 media for anther culture and in-vitro anther culture
2. In-vitro Embryo culture/embryo rescue in plants
3. Qualitative analysis of important phytochemicals.
4. To isolate peripheral blood mononuclear cells (PBMC) and perform Cell viability assay
5. To culture peripheral blood mononuclear cells

References and Textbooks for Practical:

- Basic Cell Culture A Practical approach by J M Davis, Oxford University press
- Ian R. Freshney, Culture of animal cells: a manual of basic technique and specialized applications, 6th Ed., Willey Blackwell pub.

Name of faculty: Science	**Department:** Biotechnology
Program: M.Sc. Biotechnology	**Type:** Theory + Practical
Subject:SEC-1 Molecular Biology Techniques (Elective)	**Semester:** 7
Credit: 04 + 02	**Total learning hours:** 60

Course description:
Insights into basic and advanced concepts of molecular techniques and methods which will exemplify different types of Polymerase chain reactions and their diverse applications. This course may help to understand methodology and principle of advanced high throughput sequencing techniques. In addition, this course may recognize the difference between various molecular techniques as well as their strength and limitations

Student learning outcome: After the completion of this course, students will be able to:

- Familiarize with concepts pertaining to basic and advance molecular biology principles and techniques for understanding various contemporary areas of research and their applications mainly gene isolation and characterization
- Understand and analyse the experimental data for advanced molecular biology related applications
- Evaluate selectivity and specificity of vectors for cloning genes and their expressions
- Learning basic and advanced techniques for assigning gene function, protein extraction, purification and will familiarize with advanced protein characterization techniques.
- Compare and contrast different methodologies used in molecular biology in order to solve biological problems

UNIT-1 Principle and methods for isolation of nucleic acid and proteins (6 hours)
1.1 Composition and structure of DNA and RNA
1.2 Isolation and separation of nucleic acids (DNA & RNA)
1.3 Quantification procedures: Spectrophotometer, Pulse-field gel electrophoresis and bioanalyzer
1.4 Elution and recovery of nucleic acid from gel

Unit-2 Manipulation of Nucleic acids (7 hours)
2.1 Types and characteristics of restriction modification (R-M) system
2.2 Optimization of transformation efficiency: Dam and Dcm methylases of *E. coli*
2.3 Joining DNA molecules: (DNA ligase, Adaptors & Linkers, Homopolymer tailing, Joining DNA molecules without DNA ligase)
2.4 Role and Applications: DNA and RNA Polymerases, Terminal transferase, Reverse transcriptase, Alkaline phosphatase, T4 Polynucleotide kinase, S1 Nucleases, DNase-I, RNase-I Topoisomerase I & II (Genetic Engineering, Rastogi and pathak, Oxford Publication)

Unit-3 PCR types and nucleic acid hybridization (8 hours)
3.1 PCR: Principle and methods
3.2 Variants of traditional PCR
3.3 Advanced PCR techniques: Real-time PCR , End-point PCR, Digital PCR
3.4 Hybridization and blotting techniques: Southern & Northern

UNIT-4 Gene cloning strategies (8 hours)
4.1 TOPO TA and seamless cloning, Limitations of conventional cloning, Gateway cloning, Golden Gate Cloning
4.2 Preparation of Genomic DNA libraries using different vectors
4.3 PCR as an alternative to genomic DNA cloning
4.4 Properties and preparation of cDNA libraries
4.5 Rapid amplification of cDNA ends (RACE)

UNIT-5 DNA sequencing techniques (8 hours)
6.1 DNA sequencing techniques: Maxam-Gilbert and Sanger methods
6.2 Next generation sequencing: 454, Illumina, Nanopore, Ion Torrent, Pyrosequencing
6.3 RNA-sequencing, ChIP sequencing, Methyl sequencing/ Bi-sulfite sequencing

Unit 6 Proteomic Techniques for Analysis (8 hours)
5.1 Extraction and purification of proteins from cells & tissues
5.2 PAGE, SDS-PAGE, isoelectric focussing, 2D electrophoresis, N-terminal sequencing
5.3 Peptide fingerprinting, Mass Spectroscopy and types
5.4 Protein microarrays
5.5 Phage display libraries

Unit 7 Functional genomics and proteomics (8 hours)
7.1 EMSA and DNA-footprinting, chromosome walking, chromosome jumping
7.2 Suppression Subtractive Hybridization (SSH), DNA Microarrays, SAGE
7.3 Methods for studying protein interactions
7.4 Protein structure determination, prediction and threading, Bioinformatics for protein interaction studies

UNIT-8 Biotechnology applications for human welfare (7 hours)
8.1 Riboswitches, Aptamers and their Applications
8.2 Telomerase Structure, Function and applications
8.3 Fundamentals of RNAi and siRNA, Virus induced gene silencing and its applications.
8.4 Site directed mutagenesis, Transposon mutagenesis, Genome editing: ZFN and TALENS, CRISPR/ CAS system and their applications.

References and Textbooks:

1. Primrose S & Twyman R, Principles of Gene Manipulation and Genomics, 7th ed, Blackwell, 2006 6. ISBN 978-1405135443
2. Peter J. Russell, Reed College, iGenetics: A Molecular Approach, 3rd Edition,Pearson Publishers, ISBN 9780321569769
3. T. A. Brown, Gene Cloning and DNA Analysis: An Introduction 7th edition, Wiley Blackwell, 978-1119072560
4. Andreas Hofmann, Samuel Clokie, Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, 978-1316614761

5. Jolls. O and Jornvali H (eds) 2000: Proteomics in functional genomics, Birkhauser veriog, Basel, Switzerland. ISBN 978-3034884587
6. Smita Rastogi and Neelam Pathak, Genetic Engineering, Oxford Higher Education, ISBN 978-0195696578
7. Pennington, S. and Dunn M. Proteomics from protein sequence to function. New Delhi: Viva Books Private Limited; 2002. ISBN 978-8176492904

PRACTICALS

i. Extraction of DNA and gel electrophoresis
ii. Restriction digestion of DNA/Plasmid
iii. To perform Polymerase chain reaction.

References and Textbooks for Practical's:

1. Philippa D. Darbre, Introduction to Practical Molecular Biology, Wiley–Blackwell, ISBN- 978-0471919650
2. T.A Brown, Essential Molecular Biology: A Practical Approach VolumeII, Oxford University Press; 2nd edition, ISBN-978-0199636440

Name of Faculty: Science	**Department:** Biotechnology
Program: M.Sc.	**Type:** Theory
Subject: Bioethics & Biosafety	**Semester-**7
Credit: 04 + 02	**Total Learning Hours:** 60
Course Description: This course introduces students to basic concepts of Bioethics & Biosafety. It will also inculcate the importance, need & applications of these areas in the students of any applied science branch. It will provide information about rules, regulations, laws, acts & protocols regarding bioethics & biosafety to be followed in different fields of science.	
Student Learning Outcome: After completion of the course, students will be: 1)Student will be able to appreciate the importance of Bioethics & Biosafety 2)Student will be able to implement necessary bioethics rules & regulations wherever needed in practice 3) Student will be able to identify the need of safety & will to execute it in practical life.	

Unit 1 Introduction (07 Hours)
1.1 History & Definitions of Ethics & bioethics
1.2 History & Definitions of Safety & Biosafety
1.3 Applications of Bioethics
1.4 Applications of Biosafety
1.5 Environment Ethics

Unit 2 Ethical, Legal, Social Issues – I (09 Hours)
2.1 Prenatal Diagnosis & Genetic manipulation
2.2 Biotechnology
2.3 Genetically modified Organism: Foods & Crops
2.4 Stem Cell Research
2.5 Organ transplantation & Xenotransplantation

Unit 3 Ethical, Legal, Social Issues – Ii (09 Hours)
3.1 Biodiversity & Resource management
3.2 Human & animal Cloning
3.3 Animal Testing & Animals in Research
3.4 Testing of Drugs on Human Volunteers
3.5 Assisted Reproductive Technologies (ART)

Unit 4 Hazardous Materials – Handling & Disposal (07 Hours)
4.1 Hazards & Biohazards (biological agents) with their types/ categories
4.2 Disposal of chemical wastes & hazardous wastes
4.3 Material Safety Data Sheet (MSDs)
4.4 Controlling the exposure to hazardous substances
4.5 Duties, immunization & first aid of employees

Unit 5 Risk Assessment & Containment (07 Hours)
5.1 Risk Assessment

5.2 Containment Levels
5.3 Containment in Animal lab
5.4 Containment in Plant tissue culture Lab
5.5 Containment in Microbiological lab

Unit 6 Biosafety (07 Hours)
6.1 Risk Assessment of Planned introduction & Biotechnology products
6.2 Planned introduction & Field trials of GM plants
6.3 Planned introduction of GE organisms
6.4 Biosafety during industrial production
6.5 Risk & Safety management in ART & stem cell research

Unit 7 Regulations & Guidelines – I (07 Hours)
7.1 NIH guidelines
7.2 ICH International Community Harmonization guidelines
7.3 Regulatory Framework for GE Plants in India
7.4 Indian Biosafety guidelines
7.5 Laboratory Biosafety Manual of WHO

Unit 8 Regulations & Guidelines – II (07 Hours)
8.1 Cartagena Protocol
8.2 ART regulation Bill
8.3 National Regulatory Bodies for Biosafety in India
8.4 Ethical Guidelines for Biomedical research involving human subjects
8.5 National Guidelines for Stem Cell Research

Reference Books
- Bioethics & Biosafety by M K Sateesh ,I K International Pub. Ltd
- Biotechnology Expanding Horizons by B D Singh, Kalyani Pub.

Web Resources
- Biosafety resource book by FAO http://www.fao.org/3/i1905e/i1905e00.htm
- Biosafety Manual by WHO https://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf
- ICMR Bioethics Unit https://ethics.ncdirindia.org/

Practicals
1) Case study on Bioethics
2) Project on Analysis of Biosafety measures / First aid of any Institute/lab/ Industrial unit
3) Visit to an industry to study safety measures

Name of faculty: Science	**Department:**Environmental Science
Program: M.Sc.	**Type:** Theory + Practical
Subject: DSE-1Energy and Environment	**Semester:** 3
Credit: 04 + 02	**Total learning hours:** 60

Course description:

The students are expected to understand the importance of energy conservation and become capable to identify the technologies for effective utilization of renewable energy sources.

Student learning outcome:

After learning the subject, students will be able to understand,

- Importance of renewable energy sources.
- Application of different renewable energy sources.
- Impact of energy on ecology, society and environment.
- Energy Policy of India and our energy future.
- The need, importance and scope of non-conventional and alternative energy.

Unit-1: Introduction:

Energy, Units of energy, Law of conservation of energy, Scenario of renewable and non-renewable energy sources, Needs of renewable energy, advantages and limitations of renewable energy, present energy scenario of conventional and RE sources.

Unit-2: Solar Energy:

Sun as source of energy: solar energy potential in India, National solar mission, solar radiation and its spectral characteristics, solar radiation outside the Earth's atmosphere and at the Earth's surface, flat plate and concentrating collectors, solar thermal power generation, fundamentals of solar photo voltaic conversion.

Unit-3: Wind Energy:

Wind power and its sources, modern wind energy-modern wind turbines, wind energy estimation, types of wind energy systems, site selection, details of wind turbine generator.

Unit-4: Bio Energy:

Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages of biomass energy, biomass gasification, types of gasification.

Unit-5: Ocean thermal energy:

Ocean thermal energy conversion principal, energy from tides, tidal power plants, single and double basin plants, site requirements, advantages and limitations.

Unit-6: Energy, environment and society:

Impact of energy use on the environment, fossil fuel burning and related issues of air pollution, global warming, greenhouse effect, nuclear energy and related issues of radioactive waste, social inequalities related to energy production, distribution and use.

Unit-7: Energy, ecology and environment:
Energy -production, transformation and utilization, associated environmental impacts: Nuclear accidents, pollution, construction of dams, over consumption of energy and its impact on the environment, economy and global change.

Unit-8: Energy policy and our energy future:
Energy statistics in India and world, importance of energy conservation, India's Energy Strategy(National Energy Policy), energy audit definition, energy management system, types of energy audit, Fuel and energy substitution in future.

References:

- Solar Energy: Principles of Thermal collection and storage, S.P.Sukhatme and J.K.Nayak, McGraw-Hill Education.
- Elliott, D. 1997. Sustainable Technology, Energy, Society and Environment. New York, Routledge Press.
- Sathyajith Mathew.2006.Wind energy: fundamental, resources analysis and economics. Springer Berlin Heidelberg, The Netherland ISBN: 139783540309055.
- M.V.R. Koteswara. Rao, "Energy Resources: Conventional & Non-conventional" BSP Publications,2006.
- Craig. J.R.,Vaughan, D.J.,Skinner.B.J.1996. Resources of the Earth: Origin, use and environmental impact.(2nd edition). Prentice hall, New Jersey.
- Godfrey Boyle, "Renewable Energy Power for A Sustainable Future," Oxford University Press.

Practicals:

1. Determination of calorific value by Bomb Calorimeter.
2. Solar radiation measurement methods using Pyrheliometer and Pyranometer.
3. characteristics of solar PV system
4. characteristics of Thermister.

Name of faculty: Science	**Department:** Environmental Science
Program: M.Sc.	**Type:** Theory + Practical
Subject: DSE-1 **(**Laboratory) safety and Management	**Semester:** 1
Credit: 04 + 02	**Total learning hours:** 60

Student learning outcome:

At the end of the course students will be able to...understand about

- Be aware of the factors that can lead to an accident.
- Discuss toxicology, industrial hygiene, source models, dispersion models, , fires and fire prevention, explosions and explosion prevention, electrostatics, pressure relief systems, runaway reactions, and risk analysis as they apply to chemical process safety, and be able to solve corresponding problems.
- Discuss the nature of the accident process and methods used in accident investigation, inherently safer design strategies, and the various strategies and governmental regulations relevant to process safety management.

Unit-1: Introduction of Industrial Hygiene: (7 Lecture)

1.1 Definition, scope and applications

1.2 Occupational Environmental Stress: Physical & Chemical

1.3 Airborne chemicals: Dust or aerosols (respirable and non respirable, inhalable and total dust), gases, fumes, vapours, mist and smoke.

1.4 Concept of threshold limiting values

UNIT-2: Biosafety: (7 Lecture)

2.1 Introduction; Historical Background

2.2 Introduction to Biological Safety Cabinets and types

2.3 Primary Containment for Biohazards and Biosafety Levels of Specific Microorganisms

2.4 Recommended Biosafety Levels for Infectious Agents and Infected Animals

UNIT-3: Safety Precautions: (7 Lecture)

3.1 Precautions: Process and operations involving explosives, flammables, toxic substances, dusts, vapors, cloud formation & combating.

3.2 Safety precautions for transportation for hazardous chemicals; Handling and storage of hazardous chemicals.

3.3 Respiratory personal protective equipment (RPPE) & non respiratory personal protective equipment (NRPPE): head protection , ear protection , face and eye protection , hand protection, foot protection and body protection.

UNIT-4: Fire and Explosion (7 Lecture)

4.1 Fire phenomena, classification of fire and extinguishers.

4.2 Statutory and other standards.

4.3 Fire prevention & protection system.

4.4 Explosion phenomena, explosion control devices, fire awareness.

UNIT-5: Electrical Safety: (7 Lecture)
5.1 Electricity and Hazardous, Indian standards.
5.2 Effects of electrical parameters on the human body.
5.3 Safety measures for electric works.

UNIT-6: Noise and Vibration: (7 Lecture)
6.1 Noise: generation, types and permissible limit
6.2 measurement and evaluation of noise
6.3 control methods: control of source, isolation, sound proofing and practicing aspects of control of noise
6.4 vibration: generation, types and control

Unit-7: Hazards & Risk identification, Assessment and control techniques: (7 Lecture)
7.1 Hazards, Risks & detection techniques, Preliminary hazard analysis(PHA) & hazard analysis(HAZAN)
7.2 Failure mode effect analysis(FMEA), Hazard and operability(HAZOP) study.
7.3 Hazard ranking (DOW & MOND index), Fault tree analysis, Event tree analysis(ETA)
7.4 Major accident hazard control, onsite and off-site emergency plans.

Unit-8: Storage hazards: (7 lecture)
8.1 safety measures for storage of flammable liquids/solvents, acid and alkali, chlorine and ammonia
8.2 safety of storing gas cylinders, color coding, marking and ensuring safe connection of cylinder
8.3 design of storage shed or go-down, retention basin, catch pot or dump vessel. Safe placement of containers.

References and Textbooks:

- Industrial Hygiene & Chemical Safety - M.H.Fulekar: I. K.International Publishing House, New Delhi.
- Industrial Hygiene Reference And Study Guide- Allan K. Fleeger, Dean Lillquist, AIHA, 01-May-2006
- Personal Protective Equipment -Guide to Ports/Dock Workers - M.H.Fulekar : Government of India's Publication
- Fundamentals of Industrial Hygiene-Barbara A. Plog, Patricia J. Quinlan, National Safety Council Press, 2002
- Occupational safety management and engineering, Willie Hammer, Dennis Price, Prentice Hall, 2001
- Industrial Safety and Health Management, C. Ray Asfahl, David W. Rieske, Prentice Hall, 31-Jul-2009
- Fundamentals of Occupational Safety and Health, Mark A. Friend, James P. Kohn, Government Institutes, 16-Aug-2010
- Handbook of occupational safety and health, Louis J. DiBerardinis, John Wiley, 1999

- Occupational Hygiene. Blackwell Science, Harrington, J.M. & K. Gardiner. 1995, Oxford.
- Industrial Hygiene Evaluation Methods. Micheal S. Bisesi. CRC Press, 28-Aug-2003

Practicals:

1. Preparation of Material Safety Data Sheet for some common chemicals.
2. To neutralize the given sample using NaOH / HCL/ $CaCO_3$
3. Determination of CO_2 from the atmosphere by volumetric method in a workplace Environment.
4. Estimate Noise Levels at different locations.