B. E. SYLLABUS

BIOTECHNOLOGY

VII & VIII SEMESTER

With
Scheme of Teaching
& Examination
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<tr>
<th></th>
<th>Name</th>
<th>Qualification</th>
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<tbody>
<tr>
<td>1</td>
<td>Dr. C. Vaman Rao</td>
<td>Ph.D.</td>
<td>Prof. &amp; Head</td>
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<td>2</td>
<td>Dr. Ujwal P.</td>
<td>Ph.D.</td>
<td>Assoc. Prof.</td>
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<td>3</td>
<td>Dr. Vidya S.M.</td>
<td>Ph.D.</td>
<td>Assoc. Prof.</td>
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<td>4</td>
<td>Dr. Shyama Prasad S.</td>
<td>Ph.D.</td>
<td>Assoc. Prof.</td>
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<td>5</td>
<td>Dr. D.M. Chetan</td>
<td>Ph.D.</td>
<td>Assoc. Prof.</td>
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<td>6</td>
<td>Mr. Venkatesh Kamath H.</td>
<td>M.Tech., (Ph.D.)</td>
<td>Asst. Prof. Gd II</td>
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<tr>
<td>7</td>
<td>Mr. Vinayaka B. Shet</td>
<td>M.Tech., (Ph.D.)</td>
<td>Asst. Prof. Gd II</td>
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<tr>
<td>8</td>
<td>Mr. Anil Kumar H.S.</td>
<td>M.Sc., (Ph.D.)</td>
<td>Asst. Prof. Gd I</td>
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<td>9</td>
<td>Mr. Bharath B.R.</td>
<td>M.Sc., (Ph.D.)</td>
<td>Asst. Prof.</td>
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<td>10</td>
<td>Mr. Sandesh K.</td>
<td>M.Tech., (Ph.D.)</td>
<td>Asst. Prof. Gd I</td>
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<tr>
<td>12</td>
<td>Ms. Louella C. Goveas</td>
<td>M.Tech.</td>
<td>Asst. Prof. Gd I</td>
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DEPARTMENT OF BIOTECHNOLOGY ENGINEERING  
NMAMIT, Nitte

Vision
To accomplish excellence in Biotechnology research and creating manpower for the benefit of society and human kind with an emphasis on present and future global needs.

Mission
To craft the students of Department of Biotechnology Engineering into competent professionals by providing academic training, technical achievements and professional leadership in research, academia and industry.

Program: B.E. Biotechnology

Program Educational Objectives (PEO’s)
The program educational objectives are set in line with Institutional and Departmental mission statements. The program educational objectives of B.E. Biotechnology are to produce professionals who later take the role of engineering professionals and researchers with following qualities:

- **PEO-1**: Apply fundamental knowledge of mathematics, principles of physics and chemistry, and biological sciences for the engineering applications.
- **PEO-2**: Demonstrate the application of biotechnological processes and engineering principles through designing of industrial biochemical processes that are of societal and industrial importance.
- **PEO-3**: Exhibit skills of handling microbial processes, biochemical analysis by making use of state of the art instruments.
- **PEO-4**: Exhibit strong, independent learning, analytical and problem solving skills with special emphasis on design, communication, and an ability to work in teams.
- **PEO-5**: To have successful career as engineering professional or a researcher through life-long learning in the field of biotechnology.

Program Outcomes (PO’s)
In addition to PEOs, the B.E. Biotechnology program established a set of Program outcomes (POs), expected to be met by every graduating student from the program at the time of graduation. Program outcomes
listed below, embrace the required outcomes as listed in Graduate Attributes (GAs) of National Board of Accreditation (NBA), India. The graduates of B.E. Biotechnology will have ability to:

(a) Apply knowledge of mathematics, physics, chemistry and biological science and engineering to analyze bioprocesses and related systems.

(b) Identify and formulate and solve bioprocess engineering problems.

(c) Design bioprocess systems involving unit operations, reacting systems, reactors and product purification systems.

(d) Design and conduct experiments, as well as to analyze and interpret data.

(e) An ability to function on multidisciplinary teams.

(f) Understand professional and ethical responsibility.

(g) Communicate effectively, work independently, and practice leadership and teamwork.

(h) Use the techniques, skills, and modern engineering tools necessary for engineering practice.

(i) Design system, components or processes to meet realistic needs of society, environment, health and safety, and sustainability.

(j) Recognize the need for, and an ability to engage in life-long learning.

(k) Acquire knowledge of contemporary issues.

To ensure that we achieve these key outcomes, every B.E. Biotechnology course has a clearly defined set of outcomes that overlap the program objectives (a-k) listed above.
# DEPARTMENT OF BIOTECHNOLOGY ENGINEERING
## SCHEME OF TEACHING
### VII Semester

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### Electives:

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<td>BT822 Modeling and Simulation of Biosystems</td>
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IMMUNOLOGY

Subject Code : BT701
Credits : 04
Hrs/Week : 4
Total Hours : 52

OBJECTIVE
This course on immunology aims at studying various aspects of human immune system, its types, functioning and its response to foreign materials. This subject also aims at studying related topics such transplantation and immunological disorders.

UNIT - I
THE IMMUNE SYSTEM
Introduction, Innate and Adaptive immune response, Cells of the Immune system: Monocytes, Lymphocytes, NK cells, Neutrophils, Eosinophils and Basophils, Antigen presenting cells: Macrophage, Langerhan’s cells, Dendritic cells, B lymphocytes, Organs of the immune system (Structure and function): Thymus, spleen, MALT, Peyers patch, Bursa fabricius, lymph nodes, tonsils and appendix. Artificial immunity: Vaccines: Conventional, whole organisms, recombinant vaccines, subunit vaccines, DNA vaccines, Antigens: Characteristics of antigens and haptens, adjuvants, Major histocompatibility complex and HLA antigens: Structure of class I and II MHC molecule, Peptide interaction with class I and class II MHC molecules and their role in immune response. Complements and their biological functions: Classical, alternate and lectin pathways, Biological consequences of complement activation 15 Hrs

UNIT - II
IMMUNE RESPONSE
Humoral Immunity, Types of immunoglobulins and their physiological role, Fine structure of antibody, isotypes, allotypes and idiotypes, B lymphocytes, B-cell receptors, B-cell co-receptors, B Cell maturation, B cell activation and differentiation, Genetic control of antibody production and organization of antibody genes, Mechanism of rearrangements in antibody genes, Allelic exclusion and generation of antibody diversity, Class switching mechanism and expression of immunoglobulin genes.
Cell-Mediated Immunity: Antigen processing and presentation: Endocytic and cytosolic pathways, T-cells: characteristics, ontogeny,α, β and γδ T- cells, T-cell receptor (TCR), T-cell maturation, T-cell activation, co-stimulatory signals, clonal expansion
and clonal anergy, Cytotoxic T-cells, activation and destruction of target cells, Clonal selection theory, Cytokines and their role in immune response: Classification, chemical nature and functions of IL-2, IL-4, IL-5, IL-6, IFN-\(\alpha\), \(\beta\) and \(\gamma\), TNF-\(\alpha\), TGF-\(\beta\)  

15 Hrs

UNIT - III
DISEASES AND DISORDERS OF IMMUNE SYSTEM
Hyper sensitivity: Type I, II, III, IV and V, Allergic reaction, Macrophage activation and granuloma formation (ex. Tuberculosis, pathogens and nematodes), Autoimmune disorders: Autoantibodies in humans, pathogenic mechanisms (HLA and autoimmune diseases), experimental models of autoimmune diseases, Treatment of autoimmune diseases, AIDS-Secondary autoimmune disease: immunological disorders associated with AIDS  

8 Hrs

UNIT - IV
TRANSPLANTATION AND TUMOR IMMUNOLOGY
Types of grafts, immunological basis of graft rejection, Role of CMI in graft rejection, Transplantation antigen-MHC class I, Prevention of graft rejection: Immunosuppressive drugs and immunosuppression, Immune tolerance, Stem cells and their applications in transplantation, Mechanism of immunity to tumors: Brief account on tumor antigens and their classification, Immune surveillance and immunological response to tumors, Mechanism of immune evasion by tumors, Immune therapy of cancer  

7 Hrs

UNIT - V
IMMUNODIAGNOSTIC TECHNIQUES
Antigen antibody interactions: Nature of interaction, antibody affinity, forces that govern the interaction of particulate and soluble antigens. Precipitin reactions - Double immunodiffusion, radial immunodiffusion, counter current immunoelectrophoresis, immunoelectrophoresis, rocket immunoelectrophoresis, Agglutination reactions (Active and Passive agglutinations) Radioimmunoassay (RIA) and ELISA-Principles and applications, Non-isotopic methods of immunodetections: Immunofluorescence and immunocytochemistry, immunoelectron microscopy (ferritin technique), chemiluminescence (immunoenzymatic)-chemiluminescent immunoassay, enzyme multiplied immunoassay, fluorescence polarization immunoassay.  

7 Hrs
TEXT BOOKS/REFERENCE BOOKS:
1. Immunology – a text book by C. Vaman Rao (Narosa Publishing house)
2. Essentials of Immunology by Roitt (Blackwell Scientific Publications)
3. Immunology by J. Kuby (W. H. Freeman)
4. Essentials of immunology and serology by J. Stanley (Thomson Publication)
5. Immunology – An introduction by I. R. Tizzard (Thomson Publication)

BIOETHICS, BIOSAFETY & IPR

Subject Code : BT702  Credits : 04
Hrs/Week : 4  Total Hours : 52

OBJECTIVE
This subject aims at studying ethical concerns about patenting of living organisms and genetic material. The objectives also include the effects of international trade, future economic systems and the ethical and social impact of Biotechnology.

UNIT - I
BIOTECHNOLOGY, SOCIETY AND LEGAL ISSUES
Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, Biotechnology and Biological knowledge in developing countries, Biotechnology and hunger: The legal and socioeconomic impacts of biotechnology, public awareness in genetic engineering – with case studies.

UNIT - II
ETHICAL ISSUES IN BIOTECHNOLOGY
Perception of ethical biotechnology, Bioethics, Autonomy, Rights, Beneficence. Interface of bioethics and law, Bioethics committee, Ethical issues in Livestock cloning, altering the human germline, ethical conflicts in biotechnology - interference with nature, ethical issues of regenerative medicine, Ethics and Environmental Impact.
UNIT - III
BIOSAFETY CONCEPTS AND ISSUES

12 Hrs

UNIT - IV
IPR AND REGULATIONS
Intellectual property rights (IPR) - Copyright, Trade mark, Trade secret, Industrial design, Geographical indications. Traditional knowledge and IPR. Plant breeder’s rights. GATT & TRIPS Agreement. Biosafety regulations -national and international guidelines with regard to rDNA technology, etc.

11 Hrs

UNIT - V
PATENT
Introduction to Patents - Types of patent applications: Ordinary, PCT, Conventional, Patent filing procedures - National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Patent databases. Licensing, Case studies of biotechnological products.

11 Hrs

TEXT BOOKS:
Sree Krishna, V. Bioethics and Biosafety in Biotechnology. New Age International Publishers
TRANSPORT PHENOMENA

Subject Code : BT703 Credits : 04
Hrs/Week : 4 Total Hours : 52

OBJECTIVE:
The study of transport phenomena concerns the exchange of mass, energy, and momentum between observed and studied systems. Mass, momentum, and heat transport all share a very similar mathematical framework, which can be exploited in analysis of system. This course combines the basic principles and theories of transport phenomena with biological systems.

UNIT - I

INTRODUCTION
Transport Processes:
Transport Processes; Levels of analysis: Molecular, Micro and Macroscopic, Continuum and shell balance; Dimensions of analysis – Cartesian, cylindrical and spherical coordinates in 1D, 2D and 3D.

Transport Equations and Transport Properties:
Molecular Transport equations: Molecular Momentum Transport (Newton’s law of viscosity), Molecular Energy Transport (Fourier’s law of heat conduction) and Molecular Mass Transport (Fick’s I Law). Equations of change in continuum: Equation of continuity, Equation of Motion (in terms of ∇ and velocity), Equation of energy (Derivation

**Self Study:** Vectors, Tensors and Vector operation.  

**UNIT - II**

**MOMENTUM TRANSPORT**

Shell momentum balance and velocity distribution in laminar flow: flow through circular tube, flow through annulus.

Equation of change for isothermal system: Equation of motion - Cases: Navier Stoke’s equation, creeping flow equation, Euler equation, Bernoulli equation.

Flow near solid surface, boundary layer theory.


**UNIT - III**

**ENERGY TRANSPORT**

Shell energy balances in Cartesian and boundary conditions. Steady state heat conduction: Slab (single and multi layer), cylinder (with and without heat generation), extended surfaces; Transient heat transfer, Biot number.

Convective heat transfer: Heat transfer coefficient, dimensionless numbers in heat transfer, convection on flat surface (forced and natural).

Equations of change in continuum: simplification to various cases.

**UNIT - IV**

**MASS TRANSPORT**

Mass and molar fluxes; Modes of mass transfer: Molecular, capillary, convective, diffusive and advective mass transfer; Shell mass balance: flux equation for convection for steady and unsteady state; boundary conditions. Numericals.

Steady state mass diffusion in a slab; composite slab and over all mass transfer coefficient; diffusion in slab with reaction; Transient diffusion and Biot number. Numericals.

**UNIT - V**

**BIOLOGICAL TRANSPORT PHENOMENA**

Application of transport phenomena to the following cases from biological science: Physical and flow properties of blood (Marginal
zone theory); Bioheat transfer: Furs and Fins, thermoregulation; Food sterilization; Freezing of biomaterials; Dialysis; Oxygen metabolism (uptake) of spherical bacterial aggregate; drug transport and pharmacokinetics.  

**TEXT BOOKS:**

**REFERENCE BOOKS:**
4. C.J. Geankoplis, Transport Process and Unit Operations.

**FORENSIC BIOTECHNOLOGY**

Subject Code : BT711  
Credits : 03  
Hrs/Week : 3  
Total Hours : 39

**OBJECTIVE**
The course includes the science of forensic analysis, techniques and theories of biotechnology that are helpful in the analysis procedure.

**UNIT - 1**
Definition and Scope, History and Development of Forensic science, Legal procedures and use of court. Services of the crime laboratory: Basic services and Optional services provided by full service crime laboratories, Functions and duties of forensic scientist  

6 Hrs
UNIT - II

FORENSIC ANALYSIS & BIOLOGY
Analysis of Physical evidence: Common types of physical evidences, Collection and preservation, Analysis of common evidences. Forensic Pathology: Rigor mortis, Livor mortis, Algor mortis. Forensic Anthropology, Forensic Entomology, Forensic Psychiatry, Forensic Odontology, Forensic Engineering, DNA Analysis, Dactyloscopy or Fingerprints: Classification and patterns. 8 Hrs

UNIT - III

COMPUTER AND DIGITAL FORENSIC

UNIT - IV

APPLIED FORENSIC STATISTICS
Weight of evidence and the Bayesian likelihood ratio, Transfer evidence: Basic concepts in transfer of evidence interpretation, Match Frequencies, Correspondence Frequencies, The Bayesian method for simple and complex cases. Application of statistics to particular areas of forensic science: Evidence from blood, DNA fingerprinting, Probability of paternity. 8 Hrs

UNIT - V

ETHICS IN FORENSIC SCIENCE
The importance of professional ethics to science practitioners, Development of a code of conduct and code of ethics for forensic science, Application of codes and ethics, How ethical requirement, impact the daily work of a forensic scientist, ethical dilemmas and their resolution. Ethical issues involving professional practice, Ethical issues involving technical competence 8 Hrs

TEXT BOOKS:
2. Introduction to forensic Sciences, 2nd Ed. By William Eckert, CRC Press
8. The Use of Forensic Anthropology by R. B. Pickering & D. C. Bachman, CRC Press.

ECONOMICS & PLANT DESIGN

Subject Code : BT712 Credits : 03
Hrs/Week : 3 Total Hours : 39

OBJECTIVE
The course includes the process design and development, general design consideration for the plant along with the cost estimation.

UNIT - I
PROCESS DESIGN DEVELOPMENT
Design project procedure, design information from the literature and other sources of information, Technical feasibility survey, process development, flow diagrams, preliminary design, comparison of different processes, firm process design, equipment design and specialization, scale up in design, safety factors specifications. 7 Hrs
UNIT - II
GENERAL DESIGN CONSIDERATIONS
Marketability of the product, availability of technology, raw materials, equipment, human resources, land and utilities, site characteristics, plant location, plant layout, plant operation and control, utilities, structural design, storage, materials handling, materials and fabrication selection, optimum design and design strategy. Waste disposal, govt. regulations and other legal restrictions, community factors and other factors affecting investment and production costs, safety and hazard control measures. 8 Hrs

UNIT - III
CAPITAL INVESTMENTS AND MANUFACTURING COSTS
Fixed capital investments including land, building, equipment and utilities, installation costs, (including equipment, instrumentation, piping, electrical installation and other utilities), working capital investments. Manufacturing Costs: Direct Production costs (including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.), fixed charges (including depreciation, taxes, insurance, rental costs etc.). 9 Hrs

UNIT - IV
PLANT OVERHEADS, DEPRECIATION & TAXES
Administration, safety and other auxiliary services, payroll overheads, warehouse and storage facilities etc. Cost analysis: Factors involved in project cost estimation, methods employed for the estimation of capital investment, estimation of working capital. Depreciation calculation methods. Equivalence after Taxes. Cost comparison after taxes. Conceptual numericals. 8 Hrs

UNIT - V
PROFITABILITY ANALYSIS, FINANCIAL STATEMENTS AND REPORTS
TEXT BOOKS:

RESEARCH METHODOLOGY

Subject Code : BT713  
Credits : 03  
Hrs/Week : 3  
Total Hours : 39

Objectives:
A good research is base of innovations and technology development. The research carried out must have a sound background of technology, theory and mathematics. This course is framed in order to fulfill the present needs of a good research. At the end of course a student should be able to formulate research problem, define methods of carrying it out, and analyze the outcomes using appropriate mathematical tools. Research, now-a-days, is not complete unless it is published. Hence this course is designed to meet all aspects of a fruitful research.

UNIT - I

INTRODUCTION: Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, and Research Methods versus Methodology. Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Research Ethics.

DEFINING THE RESEARCH PROBLEM: Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem.


UNIT - II

MEASUREMENT AND SCALING TECHNIQUES: Measurement in Research, Measurement Scales, Sources of Error in Measurement.
METHODS OF DATA COLLECTION: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some other Methods for Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

PROCESSING AND ANALYSIS OF DATA: Processing Operations, Some problems in Processing, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Simple Regression Analysis, Multiple Correlation and Regression.

UNIT - III
TESTING OF HYPOTHESES (PARAMETRIC OR STANDARD TESTS OF HYPOTHESES):

CHI-SQUARE TESTS: Chi-square as a Test for Comparing Variance, Conditions for the Application of $X^2$ Test, Steps Involved in Applying Chi-square test, Caution in Using $X^2$ Test.

ANALYSIS OF VARIANCE AND COVARIANCE: The Basic Principle of ANOVA, ANOVA technique, Setting up Analysis of Variance Table.

UNIT - IV
DESIGN OF EXPERIMENTS: Classical One variable method. Two factorial design, Placket Burman design, Taguchi design, Response surface methodology: Experiment design, Mathematical analysis (Model building, Coefficients, ANOVA, regression coefficient, Std. error), analysis of results, analysis of plots.

UNIT - V

THE COMPUTER - IT’S ROLE IN RESEARCH: Softwares used for research – Analysis (MS Excel, Open office, Statistical softwares – freeware, Optimization softwares, Plotting softwares), Presentation (LaTeX, MS Power point, Open office, Other freewares for diagrams and flow charts). 8 Hrs

TEXT BOOKS:
5. VTU Web portal – LaTex tutorial/http.research.vtu.ac.in

BIOFUELS ENGINEERING
Subject Code : BT715  Credits : 03
Hrs/Week : 3  Total Hours : 39

OBJECTIVE
To learn the fundamental concepts of biofuels, types of biofuels, their production technologies. To learn the concepts of feedstock utilization and energy conversion technologies.

UNIT - I

INTRODUCTION
Description of Biofuels; Energy Use & Efficiency; Biofuel Production – I and II generation biofuels; Alternative Energies; Biochemical Pathways Review for Organoheterotrophic, Lithotrophic & Phototrophic Metabolism; Importance of COD; Biofuel Feedstocks: Biomass, Starch, Sugar, Lignocellulosic, Agro & Industrial by-
products. Biomass production for fuel – algal cultures, yeasts (Lipid and carbohydrate). Fuel production through biomass incineration. **7 Hrs**

**UNIT - II**

**PRODUCTION OF BIODIESEL**


**UNIT - III**

**PRODUCTION OF BIOETHANOL**

Process Technology for Bioethanol production using Sugar; Starch and Lignocellulosic Feedstocks; Byproducts of biodiesel industry as feedstock; Selection of micro-organisms and feedstock – ethanol tolerance; Associated Unit Operations; Determination of Bioethanol yield; Recovery of Bioethanol; Process Integration. Advances in bioethanol production. **8 Hrs**

**UNIT - IV**

**PRODUCTION OF BIOHYDROGEN**

Enzymes involved in H₂ Production; Photobiological H₂ Production: Biophotolysis and Photofermentation; H₂ Production by Fermentation: Biochemical Pathway, Batch Fermentation, Factors affecting H₂ production, Carbon sources, Process and Culture Parameters; Detection and Quantification of H₂. Reactors for biohydrogen production. Advances in biohydrogen production technology. **8 Hrs**

**UNIT - V**

**MICROBIAL FUEL CELLS**

Biochemical Basis; Fuel Cell Design: Anode & Cathode Compartment, Microbial Cultures, Redox Mediators, Exchange Membrane, Power Density; MFC Performance Methods: Substrate & Biomass Measurements, Basic Power Calculations, MFC Performance: Power Density, Single vs Two-Chamber Designs, Wastewater Treatment Effectiveness; Advances in MFC. **8 Hrs**
REFERENCE BOOKS:

ENVIRONMENTAL BIOTECHNOLOGY
Subject Code : BT721 Credits : 03
Hours/Week : 3 Total Hours : 39

OBJECTIVE
The subject explains environmental perturbation, bioaccumulation of xenobiotics and its biomonitoring. Focuses on waste water and solid waste management. Explain important biotechnological principles and processes in environmental management and in the production of valuable products.

UNIT - I
BIOACCUMULATION AND BIOMONITORING

UNIT - II
WASTE WATER MANAGEMENT
Waste water characteristics, biological waste water treatment – preliminary treatment: screeners, grid chambers; primary treatment: sedimentation, types of settling, types of sedimentation tank, chemical aided sedimentation; secondary biological treatment: activated sludge process and trickling filters tertiary treatment: solids removal
biological nitrogen removal, biological phosphorous removal, disinfection. Membrane based industrial waste water treatment processes: reverse osmosis, nanofiltration, ultrafiltration and microfiltration. 8 Hrs

UNIT - III
BIOTECHNOLOGY OF SOLID WASTE MANAGEMENT
The general composition of urban solid waste, waste disposal by sanitary land filling, Aerobic treatment of solid wastes: composting, vermiculture, Anaerobic treatment of solid wastes and biogas generation, Hazardous wastes and Biomedical wastes management. 7 Hrs

UNIT - IV
BIODEGRADATION
Aerobic and anaerobic degradation, Bio-oxidation of phenolic compounds, microbial basis of biodegradation; Biodegradation of herbicides and Pesticides, Biodegradation of some specific wastes: Polycyclic aromatic hydrocarbons, Polychlorinated biphenyls, Synthetic detergents, Biosurfactants, Organonitrocompounds, Vegetable Tannins; Testing for biodegradability. 9 Hrs

UNIT - V
BIOTECHNOLOGICAL APPLICATIONS IN ENVIRONMENT MANAGEMENT
Bioremediation, Phytoremediation, Bioleaching and Biomining: metal recovery, Biopesticides: Bacteria, fungi and viruses as biopesticides, Biofertilizers: Bacteria, algae, fungi as biofertilizers, Biofilms and its applications, Bioenergy and Biofuels: Biomass resources for fuel generation, Energy recovery systems from biomass-technology evaluation, Production of Biofuel-Biodiesel, Bioethanol, Biotechnology in biodiversity conservation 8 Hrs

TEXT BOOKS:
2. Indu Shekar Thakur, Environmental Biotechnology - Basic concepts and applications, I K International
REFERENCE BOOKS:

ENGINEERING ECONOMICS

Subject Code : BT723  
Credits : 03  
Hrs/Week : 3  
Total Hours : 39

UNIT - I

Economics – Meaning, Scope, Managerial Importance - Microeconomics and Macroeconomics.
Basic Concepts – Factors of Production – Concepts of Value and Utility, the Law of Diminishing Marginal Utility.
Demand Analysis – Meaning of Demand, Demand Function, Determinants of Demand, Demand Curve, Demand Schedules, Types - Law of Demand, solutions to problems, Exceptions- Elasticity of Demand and Types of Elasticity and Determinants.
Supply Analysis – Meaning, Supply Curve and Schedule, Law of Supply, Determinants of Supply, Elasticity of Supply. 8 Hrs

UNIT - II

Demand Forecasting – Meaning, Determinants, Qualitative and Quantitative methods of demand forecasting, Problems and solutions, Discussion on managerial applications.
Profit Planning and Control – Break Even Analysis – Break Even Point (BEP), Break Even Chart, Margin of Safety, Problems and Solutions, Discussion on managerial applications, Linear Programming – graphical solution. 8 Hrs

UNIT - III
National Income – Classifications, Business Cycle – Causes and Effects, Recession and Inflation – Causes and Control. 7 Hrs

UNIT - IV
Capital Budgeting - Project Evaluation Techniques – Interest Rate Calculations, Payback Time, Present Worth, Future Worth, Annual Worth Calculations – Comparison and evaluation of investment proposals.
Depreciation – Reasons for Depreciation, Types of Depreciation, Methods of Computing Depreciation – solutions to problems. 7 Hrs

UNIT - V
Project Planning - Characteristics of a project, project proposal process, proposal contents.
Controlling Cost and Schedule - Crashing the Project completion duration and cost using network analysis 9 Hrs

TEXT BOOKS:
WASTE WATER TREATMENT

Subject Code : BT724  Credits : 03
Hrs/Week : 3  Total Hours : 39

OBJECTIVE:
To learn water quality and its standards. To learn various methods of waste water treatment like primary, secondary and biological treatment. To learn reclamation and reuse of treated water and performance analysis of treatment plant.

UNIT - I
WATER AND WASTE WATER ENGINEERING AN OVERVIEW
Constituents of waste water, Physical chemical and biological parameters of waste water, sampling methods, Waste water effluent standards, Sewage disposal: Methods of disposal. 7 Hrs

UNIT - II
PRIMARY AND SECONDARY TREATMENT OF WASTE WATER
Screens, Oil traps grease chambers, detritus tank, Grit chambers, Sedimentation and Coagulation (with simple problems), Clariflocculation, Oxidation ponds and lagoons, Attached growth biological treatment: Activated sludge process and its modifications, Trickling filter , Biological nitrification and denitrification, Anaerobic process, Sludge treatment and disposal. Disinfection: chlorine dioxide, Chloramines, Ozonation, UV radiation. 8 Hrs

UNIT - III
ADVANCED WASTE WATER TREATMENT
Removal of Dissolved organic constituents, Inorganic constituents, Biological constituents, Adsorption with principle and isotherms, Gas stripping, Ion exchange, advanced oxidation process.
Membrane filtration: RO, UF, MF, NF, Electrodialysis 8 Hrs
UNIT - IV
WASTE WATER RECLAMATION AND REUSE
Waste water reuse application, Need for water reuse, public health and environmental issues in water reuse, Introduction to risk assessment for water reuse, Different reuse options: Agriculture and landscape irrigation, Industrial reuse, ground water Recharge, Nonportable uses with case studies.

UNIT - V
ISSUES RELATED TO TREATMENT PLANT PERFORMANCE
Need for upgrading treatment plant performance, odour management, introduction to automatic process control, energy efficiency, upgrading waste water treatment plant performance by process optimization, important design consideration for new waste water treatment plants : liquid stream, solid processing, odour control. 9 Hrs

REFERENCE BOOKS:

SOLID & HAZARDOUS WASTE MANAGEMENT
Subject Code : BT725      Credits : 03
Hrs/Week     : 3          Total Hours : 39

OBJECTIVE:
To learn types of solid wastes, collection, treatment and disposal methods. To understand various processing techniques and regulations of treatment and disposal.
UNIT - I
INTRODUCTION TO SOLID AND HAZARDOUS WASTES
Solid waste – Definition, Sources of waste, Classification of Solid waste, Characteristics of Solid Waste (Physical, Chemical, Biological), Hazardous Waste Definition - Properties and classification of hazardous waste. Solid and Hazardous waste problems – impact on environment and health. Concept of waste reduction, recycling and reuse. Legislative trends and impacts: Major legislations, Government agencies. 6 Hrs

UNIT - II
WASTE COLLECTION, SEGREGATION AND TRANSPORTATION
Waste collection and segregation: Solid waste generation, Onsite handling and segregation of wastes at source, Collection and storage of municipal solid wastes, Equipments used and manpower required in collection, Collection systems and routes, Handling, collection, storage of hazardous wastes. Transportation: Transfer stations: types, location, maintenance, Methods and means of transportation, Transport of hazardous waste (Bulk and Non Bulk Transport), Labelling and handling of hazardous wastes, Manpower requirements. 9 Hrs

UNIT - III
PROCESSING TECHNIQUES AND RECOVERY OF RESOURCES
Processing Techniques: Unit operations for separations and processing, mechanical and thermal volume reduction, Incineration of solid wastes – process and types of incinerators (liquid injection, rotary kiln and fluid bed), Biological processing – composting, vermicomposting, biomethanation, fermentation, Hazardous waste processing: Physical, chemical and thermal treatment of hazardous wastes – solidification, chemical fixation, encapsulation, pyrolysis and incineration. Drying and dewatering of wastes. Recovery of Resources: Heat recovery in incineration process, energy recovery and conversion of products from biological processes. 10 Hrs
UNIT - IV
DISPOSAL OF WASTES
Dumping of solid wastes, Landfills – Types, site selection, preliminary design, operation, case study, Advantages and disadvantages of landfills, Leachate and landfill gases: Collection and treatment, Landfill disposal for hazardous wastes.  

8 Hrs

UNIT - V
SOLID WASTE MANAGEMENT RULES AND PLANNING ISSUES
Municipal Solid Waste Management Act (1999), Hazardous Wastes (Handling and Management) Rules, Biomedical Waste (Handling and Management) Rule (1998)  
Planning and developing a site for solid waste management, Site Remediation: Assessment and Inspection, Remedial techniques, Siting guidelines.  

6 Hrs

REFERENCE BOOKS:
SEMINAR

Subject Code : BT705  
Credits : 02
Hrs/Week : 3

An Individual seminar given by student on either
i. Project topic (literature, methodology)
ii. Topic of his/her choice

Only internal evaluation (CIE = 50 marks) shall be conducted. The CIE marks breakup shall include weightage for seminar report, open room presentation, viva and attendance (for all presentations).

DOWNSTREAM PROCESSING LAB

Subject Code : BT706  
Credits : 02
Hrs/Week : 3

EXPERIMENTS
5. Product enrichment operations: Two – phase aqueous extraction.
7. Separation of Amino acids, Carbohydrates and Lipids by TLC.
9. Recovery and Estimation of % ethanol from fermented broth.
10. Recovery and Estimation of Citric acid from fermented broth.
IMMUNOLOGY LAB

Subject Code : BT707         Credits : 02
Hrs/Week     : 3

EXPERIMENTS
1. Ouchterlony Double Diffusion (ODD)
2. Radial Immunodiffusion (RID)
3. Quantitative precipitin assay (QPA)
4. ELISA- Dot blot assay and with ELISA Reader.
5. Countercurrent immunoelectrophoresis (CCIEP)
6. Immunoelectrophoresis (IEP)
7. Rocket immunoelectrophoresis (RIEP)
8. Western blotting technique
9. Agglutination technique: Blood group active agglutinations test and passive latex agglutination test (RA test or pregnancy test) or Bacterial Agglutination Technique-Widal test (Tube agglutination)
10. Differential staining of WBC’s and Lymphocyte isolation by Hi-sep method
11. Total count of WBC
12. Total count of RBC
13. Serial Dilution: Agglutination and immunoprecipitation techniques

INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP

Subject Code : BT801         Credits : 04
Hrs/Week     : 4

OBJECTIVE
The objective is to introduce the technology and engineering interaction with management. Management interferes in the design, planning and operation of the technical systems. The students will learn as how to evaluate and finance these, why technology is not
enough, why we need management and planning in the areas of manufacturing and logistics, why management in energy generation and environmental sciences, why management in information and communication technologies.

UNIT - I
DEVELOPMENT OF MANAGEMENT THOUGHTS
Concept & definition of Management, Social Responsibilities of Management, Management and functions: Definition and functions of administration, Planning Organizing, Staffing, Directing and Controlling, Concept of Authority and Responsibility. 11 Hrs

UNIT - II
QUANTITATIVE TECHNIQUES IN MANAGERIAL DECISIONS
Concept of productivity, Measuring productivity, Network analysis, PERT, CPM analysis, Break even analysis, 11 Hrs

UNIT - III
PERSONNEL AND PRODUCTION MANAGEMENT
Types of production, Types of planning, Manufacturing planning, Factory planning, Production planning, Scheduling, Work study, Method study, Motion study. 12 Hrs

UNIT - IV
MATERIAL AND MARKETING MANAGEMENT
Functions of purchasing and material management, Quality standard & Inspection, Sources of supply, Pricing, Principles & practices, Inventory management, ABC analysis, EOQ model, Value analysis & engineering. Functions of marketing, Market research, Pricing and Promotion of sales, - Case study. 10 Hrs

UNIT - V
ENTREPRENEURSHIP
Meaning of entrepreneur, evaluation of the concept, function of an entrepreneur, development of entrepreneurship and its role and barriers in economic development. 8 Hrs
TEXT BOOKS / REFERENCE BOOKS:

BIOLOGY OF STEM CELLS
Subject Code: BT811
Credits: 03
Hrs/Week: 3
Total Hours: 39

OBJECTIVE
The subject gives broad outline of different types of stem cells and their origin, differentiation of stem cells into different types of tissues, the process of transdifferentiation and the application of stem cells in curing certain diseases.

UNIT - I
INTRODUCTION
Definition of stem cells, Unique properties of stem cells, Embryonic stem cells (ES cells), Growing of ES cells in laboratory, markers of ES cells, differentiation of ES cells. Adult stem cells (AS cells), Characteristics and locations of AS cells, Potential use of AS cells, As cell plasticity, Similarities and differences between embryonic and adult stem cells, Definition of progenitor and stem cells, Multipotent adult progenitor cells (MAPC), Amniotic fluid derived pluripotent cells, Isolation, characterization and differentiation potential of amniotic fluid derived cells, Stem cells and progenitor cells from cord blood, characteristics and cryopreservation of stem and progenitor cells from cord blood, cardiac stem cells (CSC), distribution of CSC in the heart.

TRANSDIFFERENTIATION
Definition and process of transdifferentiation, Transdifferentiation of: liver to pancreas, pancreas to liver, bone marrow to other cell types, prerequisites for transdifferentiation, transdifferentiation of non-islet
cells to islet cells-pancreatic acinar cells, bone marrow cells to islet cells, engineering other non β cells to produce insulin.  

7 Hrs

UNIT - II

ORGAN SPECIFIC STEM CELLS
Neural crest cells and stem cells, stem cells in adult brain, glial characterization of neural stem cells, adult neurogenesis in vivo. Mesenchymal stem cells (MSCs): skeletal muscle stem cells-phenotype, in bone marrow vasculature, adipose tissue derived stem cells-cell population, composition and characterization, multipotentiality, adipogenesis, osteogenesis and chondrogenesis. Stem cells in the adult kidney- stem cell therapy for renal failure, Liver stem cells, pancreatic stem cells-progenitor cells during early embryogenesis of pancreas and in adult pancreas. Adult progenitor cells as potential treatment for diabetes-defining β cells, stem cells and progenitor cells,

9 Hrs

UNIT - III

HAEMATOPOIETIC STEM CELLS (HSCs)
Ex-vivo expansion of HSCs, circulating HSCs transplantation, nomenclature of haematopoietic colonies and lineages, colony forming units. Haematopoietic stem cells transplantation (HCT) for solid tumors-HCT as allogenic immunotherapy, allogenic immunotherapy for solid tumors; non-myeloblastic HCT for renal cell carcinoma (RCC), for other solid tumors and for melanoma, Immunoreconstitution of HCT: autologous and allogenic, HCTs for treating autoimmune diseases.

8 Hrs

UNIT - IV

APPLICATION OF STEM CELLS I
Restoration of vision: retinal neurogenesis, neurogenesis in the central visual targets, regeneration of optic tectum Repair of myocardial damage by: non resident primitive cells and resident primitive cells, myocardial regeneration in humans. Regeneration of epidermis from adult keratinocyte stem cells: characteristics of keratinocyte stem cells, keratinocyte cultivation, transplantation of keratinocyte stem cells, regeneration of epidermis.

8 Hrs
UNIT - V
APPLICATION OF STEM CELLS II
Stem cells in tissue engineering and gene therapy: Current approaches to tissue engineering, tissue engineering by mesenchymal stem cells (MSCs), ex-vivo delivery of stem cells, reconstruction of skeleton, bone, cartilage, teeth, skeletal and cardiac muscle
Ex-vivo reconstruction: cells and scaffolds, Recruitment and mobilization of distant cells
Stem cell gene therapy: gene addition, gene editing 7 Hrs

TEXT BOOKS / REFERENCE BOOKS:

PROTEIN ENGINEERING
Subject Code : BT812 Credits : 03
Hrs/Week : 3 Total Hours : 39
OBJECTIVE
This course involves engineering aspects of protein designing along with docking method, its modeling criteria etc. This course also includes Insilico drug designing, use of computers for drug designing,
UNIT - I
STRUCTURE OF PROTEINS & PREDICTION
Overview of protein structure, PDB, structure based classification, databases, visualization tools, structure alignment, domain architecture databases, protein-ligand interactions. Primary structure and its determination, secondary structure prediction and determination of motifs, profiles, patterns, fingerprints, super secondary structures, protein folding pathways, tertiary structure, quaternary structure, methods to determine tertiary and quaternary structure, post translational modification.

PROTEIN ENGINEERING AND DESIGN
Methods of protein isolation, purification and quantitation; large scale synthesis of proteins, design and synthesis of peptides, use of peptides in biology, methods of detection and analysis of proteins. Protein database analysis, methods to alter primary structure of proteins, examples of engineered proteins, protein design, principles and examples. 8 Hrs

UNIT - II
MOLECULAR MODELING
Constructing an Initial Model, Refining the Model, Manipulating the Model, Visualization. Structure Generation or Retrieval, Structure Visualization, Conformation Generation, Deriving Bioactive Conformations, Molecule Superposition and Alignment, Deriving the Pharmacophoric Pattern, Receptor Mapping, Estimating Biological Activities, Molecular Interactions: Docking, Calculation of Molecular Properties, Energy Calculations (no derivation), Examples of Small Molecular Modeling Work, Nicotinic Ligands, Sigma Ligands, Antimalarial Agents. 7 Hrs

UNIT - III
INSILICO DRUG DESIGN & COMPUTER ASSISTED NEW LEAD DESIGN
Generation of Rational Approaches in Drug Design, Molecular Modeling: The Second Generation, Conceptual Frame and Methodology of Molecular Modeling, The Field Currently Covered, Importance of the "Bioactive Conformation", Molecular Mimicry and Structural Similarities, Molecular Mimicry, Structural Similarities and Superimposition Techniques, Rational Drug Design and Chemical Intuition, An Important Key and the Role of the Molecular Model, Limitations of Chemical Intuition Major Milestones and Future
Perspectives. Introduction, Basic Concepts, Molecular Recognition by Receptor and Ligand Design, Active Conformation, Approaches to Discover New Functions, Approaches to the Cases with known and unknown receptor structure.  

**UNIT - IV**

**DOCKING METHODS**

**UNIT - V**

**COMPUTER - ASSISTED DRUG DISCOVERY**

**TEXT BOOKS / REFERENCE BOOKS :**
CANCER BIOLOGY

Subject Code : BT813  
Credits : 03  
Hrs/Week : 3  
Total Hours : 39

OBJECTIVE
The course includes biological phenomenon of cancer, molecular mechanism of carcinogenesis, treatment and techniques involved.

UNIT - I
FUNDAMENTALS OF CANCER
diagnosis of cancer.  
6 Hrs

UNIT - II
PROCESS OF CARCINOGENESIS
sequence and origin of cancer, Mutations that accelerate the development of cancer, Contribution of non-mutagenic agents, toxic and mitogenic agents and inflammation to tumorigenesis, Multi-step origin of cancer, Genetic instability and Chromosomal anomalies in cancer cells, tumor progression involving mutation, collaboration of two or more mutant genes Darwinian evolution and natural selection, Deranged control of cell differentiation during carcinogenesis, Enhanced mutability and drug resistance in cancer cells, defects in DNA repair mechanism leading to tumorigenesis.  
8 Hrs

UNIT - III
MOLECULAR ASPECT OF CANCER
with immortalization and transformation. Telomeres and Telomerases in cancer. Angiogenesis is the key for cancer progression, involvement of blood vessels in metastasis, antiangiogenic approach to combat cancer. Metastasis-Colonization, E-cadherins, epithelial-mesenchymal transition (EMT), Extracellular proteases, metastatic tropism, metastasis suppressor gene.  
9 Hrs

UNIT - IV
TUMOR SUPPRESSOR GENES
Tumor suppressor genes and their functions, genetic status of tumor suppressor genes and oncogenes-Cell fusion experiments to prove the status of tumor suppressor genes and oncogenes. Hereditary predisposition to cancer due to mutant tumor suppressor gene, loss of heterozygosity. Loss of heterozygosity of retinoblastoma gene and its
expression. The role of retinoblastoma gene in regulating cell cycle clock-cyclin dependent kinases (CDKs), CDK inhibitors, retinoblastoma proteins (pRb) and its role in cell cycle regulation, viral oncoproteins and blocking of pRb, perturbation in pRb function and tumorigenesis, the role of TGFβ in cell cycle, the role of p53 in normal cell, mutant p53 interference with normal p53 function, Mdm2 and ARF role in p53 function, inactivation of p53 and inherited mutant allele of p53 in predisposition to cancer, inactivation of apoptotic machinery by cancer cells. Other tumor suppressor genes- Neurofibromatosis (NF1), Adenomatous Polyposis Coli (APC) and von-Hippel Lindau syndrome (VHL).

UNIT - V
THERAPIES FOR CANCER
Chemotherapy of cancer, Therapy from plant derived materials, Radiation therapy. Immune therapy of cancer: nonspecific immune stimulation, vaccination against cancer, adoptive immune therapy, passive therapy with anti-tumor antibodies, cytokine therapy, nanomedicine in treatment of tumors.

TEXT BOOKS /REFERENCE BOOKS :
NANOBIO TECHNOLOGY

Subject Code : BT814
Credits : 03
Hrs/Week : 4
Total Hours : 39

OBJECTIVE
The objectives of this course includes introduction to nanotechnology, detailed study of MEMS, applications of nanotechnology in life science.

UNIT - I

INTRODUCTION
Introduction to nanoscience, A Brief History of the Super Small, Definition of nanotechnology, Nanobiotechnology, scope of nanobiotechnology, nanobiology Bottom-Up versus Top-Down; Discussions on microfabrication and nanofabrication, Nanolithography(Dip pen, photo, X-ray, Electron beam), nanosphere lithography, Structure-property relationships in materials, biomolecule-surface interactions. 7 Hrs

UNIT - II

NANOMATERIAL AND NANO TOOLS
Zero dimensional : Nano particle, 1-D: Nano wires, nano rods, 2-D: Thin films, Special nanomaterials: Buckyballs (Fullerenes), Nanotubes, Dendrimers, Nanoshells, Magnetic nanoparticle, Quantum Dot (Nanocrystals), self assembled monolayers, Scanning probe microscopy (Scanning tunneling microscopy, Atomic force microscopy).Characterization of nanomaterials: Physical, chemical and structural. Applications of nanomaterial. 8 Hrs

UNIT - III

NANOTECHNOLOGY FOR DRUG DISCOVERY & DRUG DELIVERY
UNIT - IV

MICROFLUIDICS
Microflows (Laminar flow), Micro drops, Hagen-Poiselle equation, micromixing, microvalves & micropumps, Fabrication of Soft Materials, application of Microfluidics: Lab on a chip (cellomics, immunoassay), microparticle based assays, magnetic particle in biotechnology. Micro manipulations and separations using electric fields. On chip single cell cultivation system, micro fluidic cell culture device, micro machined bioreactor. Micro chips for genomic and proteomic analysis. 9 Hrs

UNIT - V

MEMS and APPLICATIONS
Introduction to MEMS, biomems, Design of bioMEMS, Mems process steps, Biosignal Transduction Mechanisms: Electromagnetic Transducers, Mechanical Transducers, Chemical Transducers, Optical Transducers – Applications of optical and chemical transducers. Recent Developments in BioMEMS and Nanochips. DNA based BioMEMS, application of BioMems in diagnostics. Bioconjugated Nanoparticles for Biotechnology and Bioanalysis, Surgical application of MEMS. Drug delivery systems. 7 Hrs

REFERENCE BOOKS:
1. Tuan VO-Dinh, Nanotechnology in Biology & Medicine, Taylor Francis.
6. Jean Berthier Pascal Silberzan, Microfluidics for biotechnology.
7. Guozhong Cao, Nanostructure and nanomaterial.
8. Myer Kutz, Biomedical engineering and design book.
BIOPHARMACEUTICALS

Subject Code : BT821  Credits : 03
Hrs/Week : 3  Total Hours : 39

OBJECTIVE:
The subject focuses on recently developed biopharmaceutical products. Major emphasis is placed upon polypeptide based therapeutic agents, nucleic acid based drugs, neutraceuticals, and antibiotics. It explains about actual commercial products approved, how they are manufactured, detailing biopharmaceutical drug delivery and how advances in metabolomics, genomics and proteomics will likely impact upon biopharmaceutical drug development.

UNIT - I
INTRODUCTION
Biopharmaceuticals: Pharmaceuticals products of DNA technology, Traditional pharmaceuticals of biological origin: Pharmaceuticals of animal origin, plant origin, microbial origin. Production sources of biopharmaceuticals, Influences altering biological properties of biopharmaceuticals, Delivery of biopharmaceuticals, Targetting of therapeutic proteins-Monoclonal antibodies and colloidal carrier particles viz., liposomes, micelles, dendrimers. Biosimulars.  6 Hrs

UNIT - II
ANTIMICROBIAL DRUGS
of antibiotic resistance, Improvement of existing antibiotics.  8 Hrs

UNIT - III
NUTRACEUTICALS
Introduction to Nutraceuticals - Phytotherapy, nutritional therapy; Water soluble and fat soluble vitamins: Nutritional importance, deficiency diseases. Vitamin like compounds-Biotin, L-carnitine, Choline, Vitamin F, Inositol, Taurine, Minerals and trace elements acting as neutraceuticals, Probiotics and prebiotics as neutraceuticals, Assay of vitamins-Animal assays and microbiological assays.  8 Hrs

UNIT - IV
METABOLOMICS, GENOMICS AND PROTEOMICS
Introduction, Importance of metabolites in global biochemical networks, metabolome measurement techniques, applications of
metabolomics, clinical applications of metabolomics in oncology. Pharmacogenomics: single nucleotide polymorphism. Genomics in health care, Role of proteomics in cancer. 8 Hrs

UNIT - V
PHARMACEUTICAL PRODUCTS OF DNA TECHNOLOGY
First generation and Second generation therapeutic proteins-Eg., Insulin, tissue plasminogen activator, monoclonal antibodies, Viral vaccines, Interferon and Interleukins and its applications, Enzyme therapy, Gene therapy, Stem cell therapy, antisense technology in therapy. 9 Hrs

TEXT BOOKS:
1. Medical Biotechnology – S.N Jogdand.
2. A text Book of Microbiology – R.C Dubey and D.K Maheshwari
3. Cell Biology: Fundamental and Application – Gupta and Jahangir
4. Industrial Microbiology – A.H Patel
5. Fundamentals of enzymology-Nicholas C. Price and Lewis Stevens

REFERENCE BOOKS:
   Biopharmaceuticals – Gary Walsh
2. Basic Biotechnology – Colin Ratledge
3. Microbiology an Introduction – Tortora, Funk and Case
5. Industrial Microbiology – L.E Casida
MODELING AND SIMULATION OF BIOSYSTEMS

Subject Code : BT822  Credits : 03
Hrs/Week : 3  Total Hours : 39

OBJECTIVE
The main objective this course is to understand concepts of modeling, various strategies of solving model equations and simulating them. Course enlightens the modeling aspects in biological systems and strategies to simplify and analyze the system.

UNIT - I
FUNDAMENTALS

6 Hrs

UNIT - II
LINEAR AND NON LINEAR EQUATIONS
Elemental balances and degrees of reduction, extractor, absorber. Models of Enzyme kinetics (Michaelis-Menten), growth kinetics (Monod) and product formation kinetics. Receptor-ligand dynamics, RT-PCR modeling. Numerical solutions to linear and nonlinear algebraic equations.

7 Hrs

UNIT - III
ORDINARY DIFFERENTIAL EQUATIONS
Models of predator-prey, commensalism and mutualism, Structured kinetic models, pharmacokinetic models. Bioreactors modeling (MFR and PFR with linear and nonlinear kinetics), Models of heat transfer and mass transfer in bioreactor. Numerical solutions to ODEs.

8 Hrs

UNIT - IV
PARTIAL DIFFERENTIAL EQUATIONS & STOCHASTIC MODELING
Kinetics of immobilized system with internal mass transfer, diffusion across biological membranes, fluid flow in physiological vessel (blood flow), Numerical solutions to PDEs. Principles of stochastic modeling, age distribution of microbial cells, budding of yeast cells.

9 Hrs
UNIT - V

MODEL SIMULATION
Introduction to simulation languages (ASPENPLUS, MATLAB, CSMP (IBM), FORTRAN, FLOWTRAN, CHESS). MATLAB: Basic commands, plotting tools, matrices and operation, flow control, solving linear, nonlinear equations, ODEs, PDE toolbox, SIMULINK.

9 Hrs

TEXT BOOKS / REFERENCE BOOKS:

PHARMACEUTICAL CHEMISTRY

Subject Code : BT823  
Credits : 03
Hrs/Week : 3  
Total Hours : 39

OBJECTIVE
To learn the basic chemical components, reactions, importance and applications that forms the back bone of pharmaceutical industry. A general group of chemicals with few important examples is dealt.

UNIT - I
INTRODUCTION AND SUBSTITUTION REACTIONS
Introduction to pharmaceutical chemistry, classification and nomenclature of organic pharmaceutical compounds, hyperconjugation, steric effects, inductive effects and mesomeric effect. Nucleophilic and electrophilic substitution reaction in aromatic

UNIT - II
TRACE ELEMENTS AND INORGANIC DRUGS
Essential and trace elements: their role in biological systems and their toxicity. Inorganic drugs: Occurrence, preparation, physical characteristics, chemical properties, purity test, incompatibilities, assay and pharmaceutical uses of inorganic drugs such as: Aluminum hydroxide, ammonium chloride, sodium carbonate, sodium chloride, sodium thiosulfate, sodium tetraborate (borax), Magnesium carbonate, potassium chloride, Lithium carbonate, sodium nitrite, calcium gluconate, calcium carbonate, calcium chloride, calcium lactate, ferrous fumarate, ferrous sulfate, ferrous gluconate, Iron polysaccharide, silver nitrate, antimony gluconate, boric acid zinc oxide, iodine hydrogen peroxide.  

UNIT - III
PHYSICAL CHEMISTRY
Physical properties and molecular constitution: surface and interfacial tension, dielectric constant, dipole moment, refractive index, optical rotation, density, specific gravity, viscosity, molar refraction, parachor. 
Colloids and colloidal systems: characteristic features of colloids, type of colloidal system, properties of colloids and colloidal systems. Preparation and purification of colloidal solutions, stability of colloids, pharmaceutical applications. 
Solutions: Definition, types and properties, concentration, solubility and solubilization, factors affecting solubility, solvents used in pharmacy, solutions of electrolytes and non-electrolytes, isotonic solutions, dissolution and dissolution rates, distribution phenomenon, molecular weight determination.  

UNIT - IV
DRUG PREPARATIONS, PHYSICOCHEMICAL PROPERTIES AND BIOLOGICAL ACTION OF DRUGS
Introduction to medical chemistry, drug designing, discovery of lead structure (different approaches), classification of drugs on the basis of
sources, structure, site of action and mode of action, drug receptor interaction, structure activity relationship, physico chemical properties of drugs, structural features of drugs, preparation and properties of medicinally important heterocyclic compounds such as pyrrol, furan, thiophene, pyridine, pyrimidine and pyrazine. Preparation and properties of heterocyclic compounds in which benzo-ring fused with five and six membered ring containing one heteroatom: indole, quinoline and isoquinoline. General properties, chemistry, biological action, structure activity relationship and therapeutic applications of: alicyclic compounds-cyclopropane, terpenes, menthol, carotenes. General properties, chemistry, biological action, structure activity relationship and therapeutic applications of alkaloids: atropine, morphine and related compounds (codeine, thebaine), ergotamines, reserpine, ephedrine.

**UNIT - V**

**DRUG CHEMISTRY AND MECHANISM OF ACTION**

*Analgesics and antipyretics:* paracetamool, salicylic acid analogues, quinolines derivatives, pyrazolones and pyrazolodines

*Local anesthetics:* benzoic acids derivatives, lidocaine derivatives (anilides), amino benzoic acid, miscellaneous compounds such as: lignocaine, cocaine and benzocaine.

*CNS depressants:* general anesthetics, inhalation anesthetics, ultrashort acting barbiturates, dissociative anesthetics such as halothane, nitrous oxide, chloroform, thiopental sodium, ketamine.

*Anxiolytics:* sedatives, hypnotics such as benzodiazepines, barbiturates, chloral hydrate and alcohols.

*CNS stimulants:* analeptic picrotoxin, monoamine oxidase inhibitors, tricyclic compounds.

*Diuretics:* carbonic anhydrase inhibitors, thiazide, potassium sparing diuretics.

*Antineoplastic agents:* alkylating agents, antimetabolites, antibiotics, plant products, hormones.

*Cardiovascular agents:* antianginal agents and vasodilators, antiarrhythmic drugs, antihypertensive drugs, angiotensin converting enzyme inhibitors, antihyperlipidemic drugs, anticoagulants.

*Antihistamines:* H1-antagonists, H2-antagonists, propylamine derivatives, phenothiazine derivatives, piperazine derivatives

8 Hrs

9 Hrs
TEXT BOOKS / REFERENCE BOOKS:

6. Rogers Inorganic Pharmaceutical Chemistry of Lea and Febiger, Philadelphia, USA.
PROJECT

Subject Code : BT802        Credits : 10
Hrs/Week : 10

Objective: The student is exposed to research aspects like literature review, executing experiments and analysis of results. He is also exposed to documentation and report writing.

Course: A group of students (not more than 4) is assigned to a research coordinator/guide. The students must do a thorough literature review and come out with a project plan. They are expected to submit a project proposal (not more than 10 pages) including project idea, protocols, designs (if any), expected outcome, major requirements, and approximate budget. They shall present the same in a proposal seminar in front of the panel of internal examiners (involving guide) and shall get their proposal approved. The presentation must involve projected time line of the project execution.

Evaluation Pattern:
CIE: Shall involve project proposal, proposal seminar, continuous evaluation of the project progress by Guide and HOD.
SEE: Shall involve an open seminar at the end of semester where the student must present on the work executed and results. SEE marks shall have weightage for final report, open seminar, and presentation at EXPRO (Final year project competition organized by NMAMIT, Nitte).
Open Electives Offered in VIII Semester for the year 2014-15

MA8X 01 Graph Theory  
MA8X 02 Linear Algebra  
HU8X 03 Intellectual Property Rights  
PH8X 04 Advanced Materials Technology for CV & ME  
BT8X 05 Nano Technology  
BT8X 06 Instrumental methods of Analysis for CV & ME  
CV8X 07 Environmental Impact Assessment  
ME8X 08 Industrial Pollution Control  
ME8X 09 Management and Entrepreneurship  
EE8X 10 Non-Conventional Energy Systems  
EE8X 11 Linear Systems Theory  
EC8X 12 Information and Electronic Communication Technology  
EC8X 13 Robotics  
CS8X 14 Object Oriented Prog. with C++  
CS8X 15 Essentials of Information Technology  
EC8X 18 Consumer Electronics  
PH8X 19 Optoelectronic devices for EE, EC, CSE & ISE  
HU8X 20 Value Education  
CH8X 21 Natural Products Chemistry for Bio-Tech  
CS8X 22 Essentials of IT Service Industry  
MA8X 23 Statistical design and analysis of experiments  
HU8X 24 Professional & Cognitive Communiquè  
MA8X 25 Introduction to Topology

**GRAPH THEORY**

**Subject code :** MA8X01  
**Credits :** 3  
**Hrs/Week :** 3  
**Total Hours :** 39

**UNIT - I**

Introduction to graphs, digraphs, sub graphs-spanning and induced graphs, paths, cycles, connectivity, cut points, bridges, blocks.  

8 Hrs
UNIT – II
Trees, Eularian graphs, characterizations, Hamiltonian graphs.

7 Hrs

UNIT – III
Planar graphs, outer planar graphs, Euler’s polyhedron formula, Colorability: chromatic number, Five colour theorem, four colour conjecture, Chromatic polynomial.

8 Hrs

UNIT – IV
Representations of graphs: The adjacency matrix and incidence matrix. Circuit matrix, cutest matrix, Shortest paths in weighted graphs, Dijkstra’s algorithm to find shortest paths.

8 Hrs

UNIT – V

8 Hrs

Text Book:
1. F. Harary, Graph theory, Narosa Publishing House, 1988
2. Narsing Deo, Graph Theory with applications to Engg. and Comp. Sciences- PHI

Reference Books:
2. D.B. West, Introduction to Graph Theory, PHI
LINEAR ALGEBRA

Subject code : MA8X02          Credits : 0 3
Hrs/Week      : 3              Total Hours : 39

UNIT - I
Linear equations: System of linear equations and its solution sets; elementar row operations and echelon forms; matrix operations; invertible matrices, LU-factorization. 7 Hrs

UNIT - II
Vector spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces. 7 Hrs.

UNIT - III
Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functions; transpose of a linear transformation. Determinants and elementary properties. 10 Hrs

UNIT - IV
Canonical Forms: Characteristic values; similarity of matrices, Cayley Hamilton theorem, annihilating polynomials; invariant subspaces; direct –sum decompositions; invariant direct sums; diagonalization of symmetric matrices, iterative estimates of characteristic values. 8 Hrs

UNIT - V
Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization; least-squares problems; symmetric and unitary operators. 7 Hrs

Text Books:
**INTELLECTUAL PROPERTY RIGHTS (IPR)**

<table>
<thead>
<tr>
<th>Subject Code</th>
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<td>HU8X03</td>
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**UNIT - I**

**Introduction to Intellectual Property**
Invention and Creativity - Intellectual Property (IP) – Importance, Jurisprudential definition and concept of property, rights, duties and their correlation; History and evaluation of IPR – like Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications 08 Hrs

**UNIT - II**

**Agreements and Treaties**

**UNIT - III**

**Basics of Patents and Concept of Prior Art**
Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees, Invention in context of “prior art”; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, EPO, WIPO, IPO, etc.) 08 Hrs

**UNIT - IV**

**Patent filing procedures**
National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Structure of Patent document, Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting – introduction to existing schemes, Patent licensing and Agreement, Patent infringement- meaning, scope, litigation. 08 Hrs

**UNIT - V**

**Case Studies on** Patents (Basumati rice, turmeric, Neem, etc.) non-biological cases may be included– Copyright and related rights – Trade Marks – Trade secrets - Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition Technology transfer and license agreements. 07 Hrs
References:
5. Intellectual Property Today : Volume 8, No. 5, May 2001,
    - Rachna Singh Puri
    - Arvind Vishwanathan
    I.K. International Publishing House Pvt. Ltd.,

Important Links:
http://www.w3.org/IPR/
http://www.wipo.int/portal/index.html.en
http://www.ipr.co.uk/IP_conventions/patent_cooperation_treaty.html
www.patentoffice.nic.in
www.iprlawindia.org/ - 31k - Cached - Similar page
ADVANCED MATERIALS TECHNOLOGY

Subject Code : PH8X04  Credits : 03
Hrs/Week : 3  Total Hours : 39

The objectives of the course:
1. To provide our students adequate education in materials technology to have a basis for a complete understanding of current and future scientific and technological developments
2. To provide our students, adequate education regarding the material properties to handle the design problem involving materials, effectively.
3. To select a right material for a specified application from the thousands of available materials available.
4. To select a cost effective material to reduce the cost of finished product.

UNIT - I
Structures and Properties of Ceramics - Introduction, Ceramic structures: Crystal structures, Silicate Ceramics, Carbon, Imperfection in ceramics, ceramic phase diagram, Mechanical properties: Brittle Fracture of Ceramics, Stress- Strain Behavior, mechanisms of plastic deformation, Miscellaneous mechanical Considerations.
Types, processing and Applications of Ceramics - Glasses and Glass Ceramics, clay Products, Refractories, Abrasives, Cements, Advanced Ceramics, Fabrication and processing of Ceramics and applications, Fabrication and processing of Glasses and applications, Fabrication and processing of Clay Products, Powder Pressing, Tape casting.

UNIT - II
Polymer Synthesis and Processing - Polymerization, polymer additives, Forming Techniques for Plastics, Fabrication of fibers and Films and applications
UNIT - III

Processing and Applications: Fiber- Reinforced Composites,
  Structural Composites, Laminar Composites, and Sandwich Panels.  
08 Hrs.

UNIT - IV
Shape memory alloys and Metallic glasses:
Introduction to shape memory alloys, Fundamental characteristics, shape memory effect (psuedoeelasticity),Advantages and disadvantages of SMA, Methods of processing, Commercial shape memory alloys and applications.
Introduction to metallic glasses, principle, properties, processing, applications - bulk metallic glass in nanotechnology, metallic glasses for air craft structure.  
07 Hrs

UNIT - V
Introduction to Nano materials: Properties of individual nanoparticles, Semiconducting nanoparticles: optical properties, photofragmentation, coulombic explosion, Carbon clusters: small carbon clusters, C_{60} crystals, alkali doped C_{60}, larger and smaller fullerenes, other bucky balls, nanostructured crystals: natural nanocrystals, photonic crystals, nanostructured ferromagnetism: Dynamics of nanomagnets, nanopore containment of magnetic particles,ferrofluids.  
08 Hrs

Text books
Reference Books:
1. Van Vlack L.H. “Elements of Material Science” Addison-Wesley Publishers

Scheme:
1) SEE to be conducted out of 100 marks and will be reduced to 50 marks
2) Two Questions are to be set from each unit, carrying 20 marks each.
3) Students have to answer any one full question from each Unit.

NANOTECHNOLOGY

Subject Code : BT8X05
Credits : 03
Hrs/Week : 3
Total Hours : 39

OBJECTIVE
The objectives of this course includes introduction to nanotechnology, detailed study of MEMS, applications of nanotechnology. Beneficiary Branches of Engineering: EC, Mechanical, Civil.

UNIT - 1

INTRODUCTION
Introduction to nanoscience, A Brief History of the Super Small, Definition of nanotechnology, Nanobiotechnology, scope of nanobiotechnology, Bottom-Up versus Top-Down; Discussions on nanofabrication, Nanolithography(Dip pen, photo, X-ray, Electron beam), nanosphere lithography, Structure-property relationships in materials, biomolecule-surface interactions. Fabrication of Hard Materials
UNIT - II

NANOMATERIAL AND NANO TOOLS
Buckyballs (Fullerenes), Nanotubes, nanowire, Dendrimers, Nanoshells, magnetic nanoparticle, Quantum Dot (Nanocrystals), self assembled monolayers, Scanning probe microscopy (Scanning tunneling microscopy, Atomic force microscopy). 8 Hrs

UNIT - III

NANOTECHNOLOGY FOR DRUG DISCOVERY & DRUG DELIVERY

UNIT - IV

MICROFLUIDICS
Microflows (Laminar flow), Hagen-Poiseuille equation, micromixing, microvalves & micropumps, Need for the microfluidics, Fabrication of Soft Materials, application of microfluidics. 8 Hrs

UNIT - V

MEMS & APPLICATIONS
Introduction and Overview, Design of MEMS, Sensors, Electromagnetic Transducers, Mechanical Transducers, Chemical Transducers, Optical Transducers - Applications of optical and chemical transducers. Recent Developments in MEMS and Nanochips. DNA based MEMS, application of MEMS 9 Hrs

Text books:
2. Transducers and instrumentation, D.V.S. Murthy, Prentice Hall of India.
5. Micro fluidics for biotechnology by Jean Berthier Pascal Silberzan
INSTRUMENTAL METHODS OF ANALYSIS

Subject Code : BT8X06  Credits : 03
Hrs / Week : 3  Total Hours : 39

Beneficiary Branches of Engineering: Mechanical, Civil.

UNIT - I
INTRODUCTION
Types of analytical instrumental methods and their selection, role of computers in analytical methods, performance requirements of analytical instruments, and instrument calibration techniques. Principle of microscopy, light field microscopy, scanning electron microscopy, tunneling electron microscopy and applications.

UNIT - II
SPECTROSCOPIC TECHNIQUES
Basic principles and applications of UV-Visible spectrometry, infrared spectrometry, nuclear magnetic resonance spectrometry, molecular mass spectrometry. Surface spectroscopic techniques: electron spectroscopy and ion spectroscopy; atomic absorption spectroscopy.

9s

UNIT - III
CHROMATOGRAPHIC TECHNIQUES

THERMAL AND ELECTROCHEMICAL TECHNIQUES
Principles and applications of thermo-gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC). Electrochemical methods for analysis, electrochemical cells, types of electrodes, electrode potentials.

UNIT - V
ENVIRONMENTAL APPLICATIONS
Types and concentration of various gas pollutants, instrumental techniques and measurement range for carbon dioxide, sulfur dioxide, nitrogen oxides, hydrocarbons and ozone. Types of water pollutants and detection techniques.
**Text Book:**

**Reference Books:**
1. R. S. Khandpur, Handbook of analytical instruments, TMH.

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**ENVIRONMENTAL IMPACT ASSESSMENT**

**Subject Code:** CV 8X07  
**Credits:** 03  
**Hrs/ Week:** 03  
**Total Hours:** 39

**Objective:**
To equip the students with the various key elements of EIA. Pre-requisites of the course: CV 113

**UNIT - I**
Developmental activity and ecological factors; EIA, EIS, FONSI. Need for EIA studies, Baseline information, Procedure for conducting EIA, Limitation of EIA; Environmental Acts/policies.

**UNIT - II**
Frame work of impact assessment in developmental projects; Environmental setting, EIA- Objective, content, methodologies, techniques, Rapid and comprehensive EIA.  

9 Hrs
UNIT - III
7 Hrs

UNIT - IV
Public participation in environment decision making, practical consideration in preparing EIA and EIS, salient features of the project activity, Environmental parameter – activity relationship matrices.  
8 Hrs.

UNIT - V
EIA for construction project, power projects, mining projects.

TEXT BOOKS

REFERENCE BOOKS
1. Guidelines for EIA of developmental projects, Ministry of Environment and Forest, GOI

INDUSTRIAL POLLUTION CONTROL

Subject Code : ME 8X08  
Credits : 03
Hrs/ Week : 03  
Total Hours : 39

UNIT - I
1. Introduction to Pollution
Man and the environment, environmental degradation due to energy generation, consequences of pollution, sustainable industrial growth, air water and soil pollution, carbon audit.Ill effects of pollutants, Photochemical Smog, permissible concentrations.  
8 Hrs
UNIT - II

2. Meteorology
Meteorology, Wind rose, plume dispersion studies & Numerical problems  
8 Hrs

UNIT - III

3. Separation techniques
Particulates and fly ash separation techniques. Sources of Particulates Matter, fly ash properties, theory of settling processes- (problems), Single & parallel plate ESP- (problems), Bag House, Cyclone separator, Spray Tower, Scrubbers & Venturi Scrubber, merits and demerits of each.  
8 Hrs

UNIT - IV

4. Smoke and gaseous pollutants
Smoke and gaseous pollutants: formation, measurement and control techniques T.T.T.O principle-(Ringlemann Chart, Smokescope, Bosch smoke meter), Coal firing- Under feed and overfeed stocker, Domestic and Industrial Incinerators, Pollutant gaseous (So2, Co, UBHC & NOx) Their sources, measurement and control. So2-Colorimetric, scrubbing & lime stone injection method. CO- Colorimetric, IR CO analyzer & control by oxidation. UBHC- Gas chromatography, Control by after burning & floating tanks. NOx- Iso-kinetic sampling, colorimetric method, control methods in brief for Low peak combustion temperature.  
7 Hrs

UNIT - V

Water, soil, noise, plastic and odor pollution, their control methods. Pollution control Acts, Legal aspects of pollution control.  
8 Hrs

Reference Books:
2. "Air Pollution control", W. L. Faith, John Wiley
3. "Environmental Pollution Control Engineering, Wiley Eastern Ltd.,

Scheme Examination:
TWO questions to be set from each UNIT and Students shall answer FIVE full questions choosing at least ONE question from each UNIT.
MANAGEMENT & ENTREPRENEURSHIP

Subject Code : ME 8X09
Credits : 03
Hrs/ Week : 3
Total Hours : 39

UNIT - I

PLANNING: Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning Only), Steps in planning & planning premises, Hierarchy of plans.

9 Hrs

UNIT - II

DIRECTING & CONTROLLING: Meaning and nature of directing - Leadership styles Classification and meaning only), Motivation Theories (Meaning of motivation and Classification of theories; content, process and contemporary), Communication - Meaning and importance. Coordination - meaning, importance and Techniques of Coordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control(inbrief).

10 Hrs

UNIT - III
ENTREPRENEURSHIP: Concept of Entrepreneurship, Evolution of Entrepreneurship, Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship - its Barriers. Meaning of Entrepreneur; Functions of an Entrepreneur, Types of Entrepreneurs, Intrapreneur - an emerging Class.

Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

8 Hrs
UNIT - IV
SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI, Government policy towards SSI; Different Policies of SSI, Impact of Liberalization, Privatization, Globalization on SSI. Effect of WTO/GATT on SSI, Supporting Agencies of Government for SSI, Ancillary Industry and Tiny Industry (Definition Only)

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

UNIT - V
PREPARATION OF PROJECT: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Errors of Project Report; Project Appraisal, Network Analysis (Simple numerical problems to find early and late, start and finish times, critical path and total project duration).

TEXT BOOKS:
2. Dynamics of Entrepreneurial Development & Management - Vasant Desai - Himalaya Publishing House

REFERENCE BOOKS:
1. Management Fundamentals - Concepts, Application, Skill Development - Robers Lusier - Thomson -
NON CONVENTIONAL ENERGY SYSTEMS

Subject Code : EE8X10  Credits : 3
Hrs / Week : 3  Total Hours : 39

UNIT – I
Energy Sources: Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario.

3 Hrs


5 Hrs


4 Hrs


UNIT – II

3 Hrs

consideration, Advantages and Disadvantages of WECS.

5 Hrs


7 Hrs

UNIT – III


TEXT BOOKS:

REFERENCE BOOKS:
LINEAR SYSTEMS THEORY

Subject Code : EE8X11 Credits : 03
Hrs / Week : 3 Total Hours : 39

UNIT - 1
State variable analysis & design: Introduction, concept of state, state variables & state model, state model of linear systems, linearization of state equations.
State space representation using physical variables, phase variables & canonical variables. 6 Hrs
Derivation of transfer function from state model, diagonalisation, eigen values, Eigen vectors, generalized Eigen vectors.

UNIT - 2
Solution of state equation, state transition matrix & its properties, computation using Laplace transformation, power series method, Cayley-Hamilton method, 8 Hrs
Concept of controllability & observability, methods of determining the same. 6 Hrs

UNIT - 3
Pole placement techniques: stability improvements by state feedback, necessary & sufficient conditions for arbitrary pole placement Liapunov stability criteria, Liapunov functions, direct method of Liapunov & the linear system, Hurwitz criterion & Liapunov’s direct method 5 Hrs

Text Books:

Reference Books:
INFORMATION AND ELECTRONIC COMMUNICATION TECHNOLOGY

Subject Code : EC 8X12  Credits : 03
Hrs/ Week : 03  Total Hours : 39

Common elective from Electronics and Communication department - for the students of Other branches

UNIT - I
Introduction: measure of information, information content, symbols, entropy, communication channel, noise and channel capacity, discrete channels, error control, codes.
Noise & signal processing, AM/FM/PM..., sampling, PAM, TDM, PCM., Concept of spread spectrum, multiple access, cells, mobility, inter-cell handshake.  15 Hrs

UNIT - II
Microwaves: microwave devices, microwave systems and antennas, propagations, reflections and refractions terrestrial communications, ground and space components, SNR, FDMA, TDMA Etc, satellite systems and services.
Optical fiber: optical devices, transmission networks, multiplexing, WDM, OTDM, n/w management, lasers.  16 Hrs

UNIT - III
Computers communications: OSI, TCP/IP, languages, adhoc networks, security, multimedia, audio/video compression, 3G/4G N/Ws, latest trends.  8 Hrs

REFERENCE BOOKS:
R2. Kamilo Feher, "Wireless Communication &Application ", PHI.
R3. Faraouzan, "Data Communication", TMH.
R4. Gerd keiser, "Optical fiber Communication", MGH.
ROBOTICS

Subject Code : EC 8X13      Credits : 03
Hrs/ Week : 03      Total Hours : 39

Common elective from Electronics and Communication department - for Students from other branches

UNIT - I

Introduction: Historical developments, arm kinematics and dynamics, manipulated trajectory, planning and control, sensing, robot languages, machine intelligence.

Robot arm kinematics: Direct kinematics problem and inverse kinematics solution.

Robot arm dynamics: Lagrange-Euler formulation, Newton -Euler formulation equation of motion.

Planning trajectories: General considerations, joint interpolated trajectories, planning Cartesian path trajectories. 16 Hrs

UNIT - II

Sensing: Range, proximity, touch, force and torque sensing.

Low level vision: Image acquisition, illumination, geometry pre processing.

High level vision: Segmentation, description, 3D structure recognition, interpretation.

Robot programming languages: Characteristics of robot languages, task languages. 16 Hrs

UNIT – III

Robot intelligence: State space search, predicate logic, means-ends analysis, robot learning, task planning expert systems. 7 Hrs

TEXT BOOK:
T1. Fu K S. etal, "Robotics-control, sensing, machine and intelligence", McGraw Hill
REFERENCE BOOKS:
R2. Groover MP etal., "Industrial robotics", TMH

OBJECT ORIENTED PROGRAMMING with C++

Subject Code : CS 8X14  Credits : 03
Hrs/ Week : 03  Total Hours : 39

UNIT - I
Principles of object - oriented programming:
A look at Procedure Oriented Programming, object Oriented Programming Paradigm, Basic Concepts of OOP, Benefits of OOP, Object oriented languages ,Applications of OOP.

Beginning with c++:
What is c++, Applications of C++, Structure of C++ program, Basic Data types, derived data types, user defined data types, variables in c++, dynamic initialization of variables, reference variables, operators in c++, scope resolution operator, memory management operators, type cast operators, manipulators, namespace.

7 Hrs

UNIT - II
Functions in C++:
Function prototyping, Inline Functions, Default Arguments, Function Overloading

Classes and objects:
Introduction, C Structure Revisited, Specifying a Class, Defining Member Functions, Static Data Members, and Static Member Functions. Arrays of Objects, Objects as Functions Arguments, this pointer, Friend Functions, Returning Objects, Constant Member Functions.

8 Hrs
UNIT - III

Constructors and Destructors
Introduction, Constructors, Parameterised Constructors, Multiple Constructors in a Class. Constructors with Default Arguments, Copy Constructors, Dynamic Constructors, Constant Objects, Destructors.

Operator Overloading and Type Conversions
Introduction, Defining Operator Overloading, Overloading the Various Operators, Overloading the Increment and the Decrement Operators (Prefix and Postfix), Overloading the Unary Minus and the Unary Plus Operator, Overloading the Arithmetic Operators, Overloading the Relational Operators, Overloading the Assignment Operator, Overloading the Insertion and Extraction Operators, Rules for overloading operators. Type Conversions. 8 Hrs

UNIT - IV

Inheritance
Introduction, Defining Derived Classes, Single Inheritance, Protected Access Specifier, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes.

Pointers, Virtual Functions and Polymorphism
Introduction, Pointers, Pointers to Objects, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions. 8 Hrs

UNIT - V

Templates and Exception Handling
Introduction, Function Templates, Class Templates, Overloading of Template Functions.
Basics of Exception Handling, Exception Handling Mechanism, Limitation of Exception Handling.

Working with files
Classes for Files Stream Operations, Opening and Closing a File, Error Handling during File Operations. 8 Hrs

Text Books:
1. E.Balagurusamy: Object - Oriented Programming with C++, Third Edition, Tata McGraw Hill. (Chapters 1.3 to 1.8, 2.1, 2.2, 2.6, 3.5 to 3.7, 3.10 to 3.18, 4.3, 4.6 to 4.9, 5, 6, 7, 8, 9, 11, and 12).
Reference:
1. Robert Lapore: Object - Oriented Programming in Turbo C++
3. K.R. Venugopal: Mastering C++

ESSENTIALS OF INFORMATION TECHNOLOGY

Subject Code : CS 8X15  Credits : 03
Hrs / Week : 3  Total Hours : 39

Introduction to Computer Systems (Self-Study)
Introduction to Computer Systems - Basics of computer systems - Various hardware components - Data storage and various Memory units - Central Processing Unit - Execution cycle - Introduce to software and its classifications.

UNIT - I
Operating Systems

UNIT - II
Problem Solving Techniques
Introduction to problem solving - Computational problem and it's classification - Logic and its types - Introduction to algorithms - Implementation of algorithms using flowchart - Flowcharts implementation through RAPTOR tool - Searching and sorting algorithms - Introduction and classification to Data Structures - Basic Data Structures - Advanced Data Structures.

UNIT - III
Programming & Testing
Programming Basics - Introduction to Programming Paradigms and Pseudo Code - Basic programming concepts - Program Life Cycle - Control Structures - Introduction and Demonstration of 1-D Array and 2-D Array - Searching and Sorting techniques - Demonstration
Concept of memory references in arrays - Strings - Compiler Concepts - Code Optimization techniques.


8 Hrs

UNIT - IV


9 Hrs

UNIT - V

RDBMS

- RDBMS- data processing - the database technology - data models
- ER modeling concept -notations - Extended ER features
- Logical database design - normalization
- SQL - DDL statements - DML statements - DCL statements
- Joins - Sub queries - Views
- Database design Issues

9 Hrs

Integrated Project:
Project based on C/C++/JAVA & RDBMS.

References:
4. Andrew Tanenbaum, Modern Operating Systems, Pearson Education
6. Charles Crowley, "Operating Systems: A Design-Oriented Approach"
7. Dromey, R.G., How to solve it by computers, Prentice Hall, 2005
14. Programming Pearls , by Jon Bentley, Pearson Education publication
16. Tharp Alan L, File Organization and Processing, John Willey and Sons.

Note:
1. Courseware for the subject (power point and the notes) is provided by the teacher. List of references is only for additional reading.
2. Project is a team work with 3 or 4 students in a team. Project need to be carried out offline (outside the lecture hours).
3. Project work includes implementation of some information system using the concepts of programming, testing and RDBMS. Following activities are involved in the project:
   - Preparation of High level design and Detailed design document.
   - Unit Test Plan and Integrated Test Plan.
   - Coding and Unit Testing, Integration Testing.
   Students can use the following to implement the Project:
   - Programs using C/C++/JAVA Language
   - Embedded SQL can be used to connect the Front-End with the backend Database systems
Visual studio .NET 2005 (or Visual studio 6), RAPTOR tool and oracle 9i/10g to be used for the project.

4. CIE carries 50 Marks which includes Theory Assessment (40 Marks) and Project Work (10 marks). Theory Assessments will be conducted based on CAMP methodology. Project evaluation will be done using Rubrics methodology.

5. Number of hours listed for each unit are only for the class room teaching. Students are expected to give much more time to study each of the topics outside the class hours.

CONSUMER ELECTRONICS

Subject Code : EC 8X18 Credits : 03
Hrs/ Week : 03 Total Hours : 39

Common elective from Electronics and Communication department - for the students
Of other branches

UNIT - I
FUNDAMENTALS: Electricity, Particle and Wave Motions, Conduction and Radiations, dielectrics, inductors, Vac. tubes, S.S. devices, IC's further advances, Power supply, Circuit functions.
SOUND: Transducers (Micro Phone, Loud Speakers), enclosures, Recordings - disc, Magnetic, Optical, mono-stereo, Amplifiers, Multiplexers, mixers, Synthesizers, Theatre Sound, Studios, Editing.
15 Hrs

UNIT - II
VISION: B/W TV, CTV, Video tapes/discs, recording/ play back, Standards, Broad-casting, Video systems, Studios, editing, B/W, Displays, Filters, Cameras, Color displays.
15 Hrs

UNIT - III
UTILITIES: - Fax, Xerox, Calculators, Microwave ovens, Washing Machines, A/C & refrigeration, Dishwashers, ATMS, Set -Top boxes, Auto Electronics, Industrial Electronics, Robotics, Electronics in health / Medicine, nano-technologies.
9 Hrs
Syllabus of VII & VIII Semester B.E. / Biotechnology

TEXT BOOK:

REFERENCES:
R2. Kamilo Feher, "Wireless Communication & Application", PHI

OPTO ELECTRONIC DEVICES

Subject Code : PH 8X19
Hrs/ Week : 03 Total Hours : 39

The objectives of the course:
* To know the basics of solid state Physics and understand the nature and characteristics of light
* To understand different methods of luminescence, display devices and laser types and applications
* To learn the principle of optical detection, mechanisms in different detection devices
* To understand different light modulation techniques and the concepts and applications optical switching
* To study the integration process and application of optoelectronic integrated circuits in transmitters and receivers.

PART-A

UNIT – I

Display Devices
Introduction- Fluorescence, Phosphorescence, PhotoLuminescence, Cathode Luminesence, Electro Luminescence, LED, plasma displays, Liquid Crystal displays, Numeric displays . 7 Hrs.

UNIT – II

Lasers & Fibre Optics
Laser Emission and Absorption of Radiation, Population Inversion, Optical Feedback, Threshold conditions-laser losses, Laser modes-
axial & transverse, He-Ne and Liquid dye laser-construction & working.
Optical fibre - Principle construction & working, Propagation of light, signal distortion and Attenuation

PART-B
UNIT – III
Optical Detectors
Photo detector- thermal detectors, thermoelectric detectors-types, Photon Devices-types, Photoconductive detectors, Junction detectors-Photo diodes (PIN and APD), Photo Transistors, Detector Performance – characteristics, frequency response, noise aspect and sensitivity 8 Hrs

UNIT - IV
Optoelectronic Modulators
Introduction, Polarization, Birefringence, Optical activity, Electro-optic effect, Kerr modulators, scanning & switching, Magneto-optic devices, Acousto-optic effect 8 Hrs

UNIT - V
Optoelectronic Waveguides
Hybrid and Monolithic Integration, Applications of Optoelectronic wave guide devices, Construction and working of integrated transmitters and receivers-Front end photo receiver, PIN-HBT Photo receiver & OEIC transmitters 8 Hrs

TEXT BOOK:

References:
Bhattacharya “Semiconductor Optoelectronic Devices” Prentice Hall of India Pvt.,Ltd., New Delhi
Ghatak and Thyagarajan, “Introduction to Opto Electronics” New Age International Publishers

Scheme:
1) SEE to be conducted out of 100 marks and will be reduced to 50marks
2) Two questions carrying 20 marks each will be set from each unit and students have to answer any one.

VALUE EDUCATION

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Credits</th>
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<tr>
<td>HU 8X20</td>
<td>03</td>
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<tr>
<th>Hrs/ Week</th>
<th>Total Hours</th>
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<tr>
<td>03</td>
<td>39</td>
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The Objectives of the course:
1. To make the students realize the significance of values in self-development.
2. To train the students in techniques of mind control, time management and stress management.
3. To make students use the fundamentals learnt in the course in solving
   a) The problems in their own lives like intoxication, gambling, extra marital relations, generation gap, ragging, peer pressure, addiction to social networking sites.
   b) The problems pertaining to the society in general like corruption, irresponsible media, distractions among youth, gender discrimination, westernization, child abuse & animal cruelty.
4. To make students understand value of sustainable civilization, simple living and high thinking.

UNIT - I
Three components of human personality (IQ, EQ and SQ), separating men from animals, real problems of life, how to acquire knowledge. Why sense gratification is opium of the masses, three kind of people and their symptoms, ethical degradation of the society today, how mind gets out of control, anger management, different levels of consciousness (bodily platform, sensual platform, mental and intellectual), regulative principles of freedom, difference between moderation and abstinence.  

UNIT - II
Intoxication, harmful effect of alcohol on liver, central nervous system, blood, gastro intestinal tract, muscles, etc. myths and facts regarding alcohol. Harmful effect of smoking on respiratory health, strokes and heart diseases, cognitive dysfunction, passive smoking
myths and facts about smoking, Drug addiction, common neurological effects of drug addiction, physical effects.
Negative impacts of gambling, gambling vs. substance abuse, Forms of illicit sex, forms of animals cruelty, alternatives for animal experimentation.
Knowledge, attitudes and skills needed to achieve a sustainable value based global culture.  

UNIT - III
Generation gap, ragging, peer pressure, addiction to social networking sites, corruption, irresponsible media, distractions among youth, gender discrimination, westernization, child abuse, euthanasia, capital punishment, female feticide, terrorism.

Scheme:
1) SEE to be conducted out of 100 marks and will be reduced to 50 marks.
2) Three questions from units 1&2 each and two questions from unit 3 shall be set, carrying 20 marks each.
3) Students have to answer 5 full questions, selecting at least two questions from units 1&2 each and one from unit 3.
4) Break Up of CIE (50 marks):
   - First Mid Semester Exam - 10 marks
   - Second Mid Semester Exam - 10 marks
   - Class Quiz - 05 marks
   - Students' solution of problems discussed in the form of video skits - 25 marks

NATURAL PRODUCTS CHEMISTRY

<table>
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<tr>
<th>Subject Code</th>
<th>CH8X21</th>
<th>Credits</th>
<th>03</th>
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<tr>
<td>Hrs/Week</td>
<td>03</td>
<td>Total Hours</td>
<td>39</td>
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UNIT - I
UNIT - II
Sex hormones: Chemistry of estrogen, progesterone, androsterone and testosterone. Structure and synthesis of cortisone and aldosterone.
8 Hrs

UNIT - III
Prostaglandins: Introduction, nomenclature, classification and biological role of prostagladins. Structure elucidation and stereochemistry of PGE1, PGE2 and PGE3. Total synthesis of PGE1(Corey’s method).
7 Hrs

UNIT - IV
Chemistry of Porphyrins: Introduction to porphyrins, structure and degradation products of haemoglobin and chlorophyll.
8 Hrs

UNIT - V
Alkaloids: Definition, Classification and isolation of alkaloids. General methods of structural determination of alkaloids. Detailed study of structure elucidation, rearrangement, synthesis and biogenesis of the following alkaloids- papaverine, cinchonine, and morphine.
8 Hrs

References:

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ESSENTIALS OF IT SERVICE INDUSTRY  
(SPAN TECHNOLOGIES)

Subject Code : CS8X22  
Credits : 03
Hrs/week : 03  
Total Hours : 39

UNIT - I
Fundamentals of Software Industry  
3 Hrs
Introduction to SDLC Process; Life cycle models; Requirement Gathering Techniques; Functional, Non Functional, Statutory and Regulatory Requirements; Configuration Mgmt; Workshop on Requirement Analysis.

UNIT - II
Relational Database  
6 Hrs
Fundamentals of Relational Databases; Primary key, Unique Key, Foreign keys and Indexes; Logical & Physical Databases; Simple Queries.

UNIT - III
Basics of DOTNET & coding techniques  
9 Hrs
Introduction to .NET framework 3.5 with additional features of .NET 4.0; Language construct C#; Visual Studio Developer environment IDE; Coding Standards and General Coding guidelines.

UNIT - IV
ASP.NET  
12 Hrs
Page life cycle; Web.config; types of apps, control structure; HTML controls; Server controls; Custom controls; User controls; Form validation; Master Pages, Themes, Skins, CSS, Passing data between forms, Session object, view state, Request / Response; ADO.Net.
UNIT - V

Code Enabler  
Error/Exception handling; XML – Overview; Creating XML; XML validation; XPATH; XML schema, attributes, XML in SQL; Usage of Code Analysis Tools – Face, Style Cop; Jquery;IIS.

Note:
1. Courseware for the subject (Power Point Presentation) will be provided by the teacher. List of references is only for additional reading.
2. Assignment will be provided for each theory sessions. These assignments need to be carried out by each student (outside the lecture hours) independently and must be submitted within the timeframe specified by the instructor.
3. Tests will be conducted on each topics separately and test assignment score will be used for final evaluation.
4. Test score will carry a weightage of 20%, assignment 30% and rest 50% weightage would be given to the final examination.

STATISTICAL DESIGN AND ANALYSIS OF EXPERIMENTS

Subject code : MA8X23  
Credits : 03  
Hrs/Week : 3  
Total Hours : 39

UNIT – I

Curve fitting and Regression: Least square principle, curve fitting of linear, quadratic and exponential. Correlation and properties, correlation coefficients, regression analysis.  
8 Hrs

UNIT – II

Probability Theory: Review od pdf’s, expectation, variance, moment generating function and properties, Moment generating functions and their properties, random samples, sampling distributions, central limit theorem and applications.  
10 Hrs
UNIT - III
\textbf{Estimation and Testing of hypothesis:} Consistency and unbiased statistics, point and interval estimation, mean and variance, tests of hypothesis concerning mean and variances. \textbf{8 Hrs}

UNIT - IV
Functions of random variables, t, F and chi-square distributions \textbf{7 Hrs}

UNIT - V
\textbf{Analysis of variance of one-way, two-way classified data, experimental designs:} CRD, RBD, LSD, factorial experiments.

\textbf{Text Books:}
1. Irwin Miller, John E. Frund, “Probability and Statistics for Engineers” 3\textsuperscript{rd} edition

\textbf{Reference books:}

\section*{Introduction to Topology}

\textbf{Subject code} : MA8X25 \quad \textbf{Credits} : 03 \quad \textbf{Hrs/Week} : 03 \quad \textbf{Total Hours} : 39

UNIT – I
\textbf{Basics of set theory and logic:} Functions, relations, arbitrary cartesian products, principle of recursive definition, countable and uncountable sets, infinite sets and axiom of choice, well ordered set and maximum principle. \textbf{8 Hrs}

UNIT - II
Topological spaces, basis for a topology, order topology, product topology on \(X \times Y\), The subspace topology, closed sets and limit points, continuous functions. \textbf{8 Hrs}
UNIT - III
Product topology, Metric topology, Examples. 8 Hrs.

UNIT - IV
Connectedness and compactness: Connected spaces, connected sets in the real line, compact spaces, compact sets in the real line. 8 Hrs

UNIT - V
Countability and separation axioms. T₁, T₂, T₃, T₄ Spaces. 7 Hrs

Reference books:

PROFESSIONAL & COGNITIVE COMMUNIQUÉ

Subject Code : HU8X24 CIE Marks : 50
Hrs/Week : 03 Total Hours : 39

UNIT - I
Common sense: Understand the term ‘common sense’ & commonsensical consensus, unsettling commonsensical consensus. (Role of language in the growth of an individual)
Emotional Intelligence: Nature, function and types of intelligence; emotion, intelligence and creativity; Growth and development of emotional intelligence. 8 Hrs.

UNIT - II
Manners and Etiquettes - work place etiquettes, Significance of Cross Cultural understanding; Cultural Sensitivity, Impact of social Media Self-Presentation Skills.
Syllabus of VII & VIII Semester B.E. / Biotechnology

Workplace: Physical and Psychological working conditions; Workplace Readiness Skills. 8 Hrs

UNIT - III
Writing: Creative Writing, Formal writings/Informal writing, Plagiarism.
Reading and Interpretation: Styles of reading, scanning, skimming, detailed reading. 8 Hrs

UNIT - IV
Presentation Skills: Event planners coordinate and manage conferences meetings and parties. 8 Hrs

UNIT - V
Diaspora: exile, migration, old and new diasporas, the heterogeneity of diasporas, groups, especially by gender, class, sexuality, caste, religion, the role of language and other cultural practices in migratory experiences; Films and Indian Diaspora.

References:
Ray French: Cross Culture Management, Universities Press
Urmila Rai: Business Communication, Himalaya Publishing House
Neil Fiore; The Now Habit at Work: Perform Optimally, Maintain Focus, and Ignite Motivation in Yourself and Others ,Publisher: Wiley ISBN: 9780470593462
V. Geetha; Gender
http://writingexercises.co.uk/index.php
http://www.studyskills.soton.ac.uk/studytips/reading_skills.htm
http://pages.minot.k12.nd.us/votech/File/workplace.htm

INTRODUCTION TO TOPOLOGY

Subject code : MA8X25    Credits : 03
Hrs/Week : 03       Total Hours : 39

UNIT – I
Basics of set theory and logic: Functions, relations, arbitrary cartesian products, principle of recursive definition, countable and
uncountable sets, infinite sets and axiom of choice, well ordered set and maximum principle.  

UNIT - II
Topological spaces, basis for a topology, order topology, product topology on $X \times Y$, The subspace topology, closed sets and limit points, continuous functions.  

UNIT - III
Product topology, Metric topology, Examples.  

UNIT - IV
Connectedness and compactness: Connected spaces, connected sets in the real line, compact spaces, compact sets in the real line.  

UNIT - V
Countability and separation axioms. $T_1, T_2, T_3, T_4$ Spaces.  

Reference books: