### LIST OF OPEN ELECTIVES TO BE OFFERED IN THE ODD SEMESTER (CEG / ACT CAMPUS)

#### FACULTY OF CIVIL ENGINEERING

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B.E. Civil Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>CE7791</td>
<td>Project Formulation and Appraisal</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### FACULTY OF MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>ME7791</td>
<td>Fundamentals of Ergonomic principles</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>CT7791</td>
<td>Refractory Engineering</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Civil Engineering

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CE7791</td>
<td>Project Formulation and Appraisal</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Mechanical Engineering

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>ME7791</td>
<td>Fundamentals of Ergonomic principles</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Manufacturing Engineering

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>MF7791</td>
<td>Industrial and Bio-inspired Robotics</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Printing Technology

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>PT7791</td>
<td>Online Publishing</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Computer Science and Engineering

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td>CS7791</td>
<td>Agile Methodologies</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Information Science and Technology

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>IT7791</td>
<td>Internet of Things</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Ceramic Technology

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>CT7791</td>
<td>Refractory Engineering</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Biotechnology

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>IB7791</td>
<td>Biosensors</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>IB7792</td>
<td>Bioimaging</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Department of Biotechnology

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.</td>
<td>FT7791</td>
<td>Food Equipment Design and Process Modelling</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>FT7792</td>
<td>Beverages Technology</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>PM7791</td>
<td>Basics of Drug Designing</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>PM7792</td>
<td>Pharmaceutical Additives</td>
<td>OE</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
CE7791  PROJECT FORMULATION AND APPRAISAL  L T P C  3 0 0 3

OBJECTIVES:
- To study and understand the formulation, costing of construction projects, appraisal, Risk analysis and Project finance

UNIT I  PROJECT FORMULATION  9

UNIT II  PROJECT COSTING  9

UNIT III  PROJECT APPRAISAL  9

UNIT IV  RISK ANALYSIS IN CAPITAL BUDGETING  9
Introduction, Types and Sources of Risk in Capital Budgeting, Risk Adjusted Discount Rate, Certainty Equivalent Approach, Probability Distribution Approach, Sensitivity Analysis, Simulation Analysis, Decision Tree Approach

UNIT V  PROJECT FINANCING  9

TOTAL: 45 PERIODS

OUTCOME:
- On completion of this course the students will be able to know the formulations of projects, projects costing, appraisal and financing.

REFERENCES:

ME7791  FUNDAMENTALS OF ERGONOMIC PRINCIPLES  L T P C  3 0 0 3

OBJECTIVE:
To expose the students to the various aspects of Industrial Design so as to develop new products considering aesthetics, ergonomics, environment and other human factors.

UNIT I  FUNDAMENTALS OF ANTHROPOMETRY IN ERGONOMICS  9
Anthropometry and its uses in ergonomics – Principles of applied anthropometry in ergonomics – Application of anthropometry in design – Design for everyone – Anthropometry and personal space
UNIT II        ERGONOMICS IN WORK PLACE DESIGN  9

UNIT III       ERGONOMICS IN EQUIPMENT DESIGN  9

UNIT IV        ERGONOMICS IN ENVIRONMENTAL DESIGN  9
Heat, cold and the design of the physical environment – Vision, light and lighting – Hearing, sound, noise and vibration

UNIT V        COGNITIVE ERGONOMICS & HUMAN FACTOR APPLICATION  9

TOTAL: 45 PERIODS

OUTCOME:
Upon completion of this course the students will be able to understand the human aspects to be considered in the design of equipments, work spaces and various OSHA standards

REFERENCES:

MF7791        INDUSTRIAL AND BIO-INSPIRED ROBOTICS  3 0 0 3

OBJECTIVE
- To introduce the relevance of this course to the existing technology through demonstration, case studies and contribution of scientists.
- To understand the most advanced applications and working principles of robotic systems.
- To investigate animal locomotion principles such as ground locomotion, flapping flight, swimming, and water surface locomotion and adapting those principles to bio-inspired robotic platforms.
- To introduce latest state of the art robotics.

UNIT I        INTRODUCTION  9

UNIT II       INDUSTRIAL ROBOTICS  9
Industrial Robotics definition and generations - anatomy - configuration and work envelop - Path control - end-effectors, grippers and tools - selection and design - collaborative robots - human robot interaction (HRI).
UNIT III INDUSTRIAL ROBOT PROGRAMMING
Lead through Programming, Robot programming Languages - VAL Programming-Motion Commands, Sensor Commands, End Effectors commands and simple Programs. RGV, AGV: Implementation of Robots in Industries - Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

UNIT IV BIO-INSPIRED ROBOTS

UNIT V PRINCIPLES OF ANIMAL LOCOMOTION

TOTAL: 45 PERIODS

OUTCOME
Upon completing of the course students will be able to:

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world.
- Discuss the modern applications in robotics with respect to industry and biologically inspired robots
- Understand the most ongoing research topics.

TEXT BOOKS

REFERENCES
OBJECTIVES

The students should be made to:

- Understand the activities in online publishing
- Know the different file formats and layout for publishing
- Gain knowledge on designing for different media

UNIT I  INTRODUCTION 9
Introduction - Publishing, Online publishing, Self-publishing, Need for online publishing; Broad Spectrum of publishing choices – Traditional publishing, Professional self-publishing, Hybrid authorship, Agent-assisted publishing, Fully assessed publishing; Publishing Workflow; Requirements – Idea, Budget, Time; Challenges of Self-publishing. Advantages and disadvantages of online publishing.

UNIT II  LAYOUT DESIGN AND FILE FORMATS 9
File formats: Images – TIFF, JPEG, GIF, PNG, BMP, PUB; Video and Audio – AVI, MPEG, QuickTime, WAV, MIDI, PCM, AIFF, MP3; Properties and comparison; Guidelines and copyrights for image and multimedia file preparation; graphic design and layout types; Suitable layout design, Elements placement, Screen resolution selection criteria.

UNIT III  WEBSITE DESIGN 9
Introduction to HTML, Webpage design, layout, navigation; Forms, frames; Page formatting using CSS. Handling images, links, video audio animations; interactive website; digital Layout types;

UNIT IV  SEARCH OPTIMIZATION AND SECURITY 9
Introduction – SEO, Purpose, Effective usage; Optimize the search engine – Page properties, Keyword research, Fine-Tuning the headline, Post slug, Images, Categories and tags, Relevant videos, Subheads, Interlinking, External linking, Meta data, Call to action.; Security: Copyright - Terms, DRM

UNIT V  DESIGNING FOR MEDIA 9
Designing of blogs, online forums, chat Publishing content – Book, Blogs, Videos, Stories; Distribution mode – Websites, iBooks, Social media, Podcast; Gadgets - Computers, Tablets, Cellphones, Kindle. Mini project

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Create website using different layout concept.
- Handle images, audio and video files in Web Pages.
- Design layouts for media.

TEXT BOOKS:


REFERENCES:

OBJECTIVES:

- To understand importance of Mineral & Mining industry and their contribution to economic growth of the nations and to the mankind.
- To understand the methods of exploration of minerals and to establish mineral resources.
- To learn the various surface, underground mining methods, slope stability and mineral processing and its impacts on the society.

UNIT I: INTRODUCTION TO MINERAL AND MINING INDUSTRY


UNIT II: EXPLORATION GEOLOGY


UNIT III: SURFACE MINING

Classification of surface mining methods, applicability and limitations, significances of surface mining, concept of stripping ratio, Working pit slope and ultimate pit slope, common modes of slope failures, factors influencing stability of slopes, Types of waste dump – internal and external; dump formation methods and corresponding equipment; Dump stability and stabilisation measures.

UNIT IV: UNDERGROUND MINING & MINERAL PROCESSING

Classification of underground mines (coal & metals), comparisons of underground coal mining with metal mining, Rock Mechanics and Support System, Mine Closure Procedures. Ore Handling, Comminution, Screening and Classification, Concentration, Metallurgical Accounting, Ore to Concentrate and Metal

UNIT V: LEGAL FRAMEWORK OF MINERALS, MINING & ENVIRONMENT PROTECTION


OUTCOMES:

- The students will be able to choose the proper techniques of exploration and estimation of the reserves.
- They will have knowledge of different mining methods and mineral processing techniques.

TOTAL: 45 PERIODS
TEXT BOOKS:

REFERENCES:

CS7791 AGILE METHODOLOGIES L T P C
3 0 0 3

OBJECTIVES:
- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I AGILE METHODOLOGY

UNIT II AGILE PROCESSES

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING
UNIT V AGILITY AND QUALITY ASSURANCE


TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

- Realize the importance of interacting with business stakeholders in determining the requirements for a software system
- Perform iterative software development processes: how to plan them, how to execute them. Point out the impact of social aspects on software development success.
- Develop techniques and tools for improving team collaboration and software quality.
- Perform Software process improvement as an ongoing task for development teams.
- Show how agile approaches can be scaled up to the enterprise level.

TEXTBOOKS:

REFERENCES:

CS7792 SOFT COMPUTING


UNIT II Introduction to Fuzzy Set with Properties; Fuzzy Relations; Fuzzy Arithmetic; Fuzzy Logic; Defuzzification - Applications and Fuzzy Control Decision tree learning, Classification – Bayesian Learning: Bayes theorem, Naïve Bayes Classifier, Bayesian Belief Networks, EM Algorithm


UNIT IV Optimization – Particle Swarm Optimization – Ant Colony optimization– Differential evolution – Artificial bee colony optimization

UNIT V Neurons and neural networks; Basic models of artificial neural networks – single-layer perceptron, multilayer perceptron; Radial basis function networks; Recurrent neural networks; NN with backpropagation - Training of neural network

TOTAL: 45 PERIODS
TEXTBOOKS:
1. Goldberg D.E., Genetic algorithms in search optimization and machining, Pearson Education.

IT7791
INTERNET OF THINGS
L T P C
3 0 0 3

OBJECTIVES:
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I  FUNDAMENTALS OF IoT

UNIT II  IoT PROTOCOLS
Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Layer Protocols: CoAP and MQTT

UNIT III  DESIGN AND DEVELOPMENT

UNIT IV  DATA ANALYTICS AND SUPPORTING SERVICES
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT V  CASE STUDIES/INDUSTRIAL APPLICATIONS
Connecting IoT to Cloud-Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL: 45 PERIODS
OUTCOMES:
Upon completion of the course, the student should be able to:

- Explain the concept of IoT.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Raspberry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

TEXTBOOK:

REFERENCES:
   https://www.arduino.cc/  

CT7791 REFRATORY ENGINEERING L T P C 3 0 0 3

OBJECTIVES
- The course is aimed to impart basic knowledge about the refractory materials, their properties and applications.

UNIT I INTRODUCTION 10
Definition - demand and growth of refractories in India - classification of refractories. Refractory properties: physical properties - microstructure, density, porosity, permeability, pore size distribution; mechanical properties - strength, abrasion resistance, spalling resistance; thermal properties - PCE, RUL, thermal expansion, thermal conductivity, thermal shock resistance; chemical properties - composition, corrosion/slag attack resistance, CO resistance, hydration resistance.

UNIT II TYPES OF REFRACTORIES 9
Acidic refractories - silica, fireclay, high alumina; Basic refractories - magnesia, dolomite, forsterite, magnesia-chrome; Special refractories - SiC, Si₃N₄, carbon, Magnesia carbon, spinel, fused cast refractories.

UNIT III MONOLITHIC REFRACTORIES 9
Castables – types, composition, properties, applications; Plastics – types, composition, properties, applications. Dry mixes – types, composition, properties, applications.
UNIT IV  CRITERIA FOR SELECTION OF REFRACTORY MATERIALS
ASTM strength tests— Choosing best refractory for thermo-mechanical application – Verification from field test study- static compressive stress strain data-Creep data -Influence of stress state on the strength of refractories –Thermal expansion data

UNIT V  REFRACTIVE APPLICATIONS IN METALLIC INDUSTRIES
Refractory usage in Ferrous industries - blast furnace, open hearth furnace, basic oxygen furnace, electric arc furnace, induction furnace, ladle furnace. Refractory usage in non-ferrous metallic industries - copper - roasting furnace, smelting furnace; aluminium - Hall Heroult process; lead - lead blast furnace.

OUTCOME
On completion of the course the students are expected to
• Have a basic knowledge about the properties of refractories.
• Have knowledge about the different types of shaped refractories and unshaped refractories.
• Have an understanding on the criteria for selection of refractories.
• Have knowledge about the refractory applications in various ferrous and non-ferrous metal processing units.

REFERENCES

IB7791  BIOSENSORS  L T P C  3 0 0 3

OBJECTIVE:
• This course introduces students to the highly interdisciplinary field of biosensors and introduce various strategies to apply the scientific theory and mechanisms and to learn how various chemical, biological and engineering concepts are used in synergy to achieve state-of-the-art sensing of important biological molecules.

UNIT I  FUNDAMENTALS OF BIOSENSORS
UNIT II  TYPES AND DETECTION METHODS  

UNIT III  METABOLISM SENSORS  

UNIT IV  AFFINITY BIOSENSORS  

UNIT V  APPLICATIONS AND FUTURE AVENUES  
Applications of the quartz microbalance. Optical methods: UV/Vis/IR, fluorescence, luminescence, fibre optics, surface plasmon resonance. Applications in food analysis and environmental analysis. Diagnostics and other biosensor applications are discussed critically with special emphasis on sensitivity, selectivity and stability.

TOTAL: 45 PERIODS

OUTCOMES:
- Be able to extend engineering principles to electrochemical biosensor development.
- Distinguish common and different challenges of major electrochemical biosensor applications.
- Make critical design and selection decisions with respect to the target application and practical limitations.

TEXT BOOKS
   This text book is on reserve, and it is also available from UR library online resources.

REFERENCE
1. Handbook of fluorescence spectroscopy and imaging (M. Sauer, J. Hofkens, J. Enderlein)
2. Single molecule spectroscopy in chemistry, physics, and biology (A. Gräsland, R. Rigler, J. Widengren)
OBJECTIVE:
- The course aims to provide an in-depth knowledge of Bioimaging settings from single molecules to man used in medical and research applications.

UNIT I  INTRODUCTION
Types Light microscopy vs. other imaging techniques. History of microscopy; Latest developments and trends in detection methods, e.g. fluorescence, The concept of 3D imaging. Confocal and multiphoton, resolution & the diffraction limit; Label-free optical imaging methods - Raman and infrared microscopy; Holographic microscopy. mesoscopic techniques.

UNIT II  DETECTION
Detection of single-molecules in situ using FISH, FRET and FRAP methods. Introduction to advanced methods for manipulation of single cells and single molecules (optical and magnetic tweezers), correlative light and TEM, SEM & AFM and in situ liquid TEM. Cytochemistry and preparation of samples.Cellular analysis methods by analytical and preparative flow cytometry.High-throughput imaging concepts and image based cytometry; Screening tools.

UNIT III  IMAGE CAPTURE & DIGITAL IMAGES IN BIOLOGY
Digital vs. analog Image acquisition devices: CCDs vs CMOS cameras; PMTs; High-speed cameras & time-lapse acquisition.UV cameras, Thermography, Gamma & X-ray cameras.Digital image analysis. Quantitative imaging as well as in vivo imaging or live cell imaging

UNIT IV  MEDICAL IMAGING/3D CAPTURE & VISUALIZATION

UNIT V  PHYSICS AND TECHNOLOGY
Imaging with non-ionizing radiation ultrasonic imaging : ultrasound physics, image reconstruction, transducer technology, physical bases of NMR, conventional imaging sequences, chemical shift, high speed imaging,functional imaging imaging with ionizing radiation: radiation physics, different types of X-ray detectors, positron emission tomography.Development of novel methods and technologies for clinical and research applications.

OUTCOMES:
- After completing the course, the student should be able to
  - Describe different types of imaging instrumentation and their applications
  - Understand the concept of fluorescence, account for different types of image analysis techniques and their applications.

TEXTS BOOKS:
1. Principles of fluorescence spectroscopy (J. R. Lakowicz)
2. Single particle tracking and single molecule energy transfer (C. Brauchle, D.C. Lamb, J. Michaelis Eds.)
3. Optics (E. Hecht)
4. Infrared and Raman Spectroscopic Imaging (R. Salzer, H. W. Siesler Eds.)
OBJECTIVE

- To provide a technical knowledge on design of food processes and processing plants with respect to food safety and quality.

UNIT I  DESIGN OF FOOD PROCESSING EQUIPMENT  9

UNIT II  FOOD PROCESSING PLANT DESIGN CONSIDERATIONS  9
Design of evaporator, vapour separator and condenser. Design considerations for location of food plant. Equipment layout and ventilation in food process plants. Design of fluid conveyance system; pipe, sanitary pipe fitting and valves. Performance characteristics and selection of centrifugal and positive displacement sanitary pumps. Design of CIP system.

UNIT III  FUNDAMENTALS OF FOOD PROCESS MODELLING  6

UNIT IV  MODELLING OF HEAT AND MASS TRANSFER  12
Modelling and its Various Uses, types of Process Modelling, Computational or Numerical Models, Observational (Empirical) Models. Modelling of heat and mass transfer; introduction diffusion equation, the Navier-stokes equations, heat and mass transfer in porous media Luikov’s equation, combined discrete/continuous modelling.

UNIT V  APPLICATION OF MODELS IN PROCESSING TECHNOLOGIES  9

TOTAL: 45 PERIODS

TEXTBOOKS:

REFERENCES
2. Ahmad, T. Dairy Plant Engineering and Management, (Kitab Mahal, 2009)
BEVERAGES TECHNOLOGY

OBJECTIVE

- To provide a technical view of beverages and a full discussion of manufacturing processes in the context of technology and its related chemistry as well as a more fundamental appraisal of the underlying science.

UNIT I INTRODUCTION
Types of beverages and their importance; status of beverage industry in India; Manufacturing technology for juice-based beverages; synthetic beverages, fruit juices – technology, nutritional value, chemistry of major fruit juices, microbiology.

UNIT II CARBONATED BEVERAGES
Technology of still, carbonated, low-calorie and dry beverages; isotonic and sports drinks; role of various ingredients of soft drinks, carbonation of soft drinks - technology, nutritional value, chemical changes, microbiology.

UNIT III SPECIALTY BEVERAGES
Specialty beverages based on tea, coffee, cocoa, chocolate based, spices, plant extracts, herbs, nuts, dairy and imitation dairy-based beverages - technology, nutritional value, chemical changes, microbiology.

UNIT IV ALCOHOLIC BEVERAGES
Alcoholic beverages - types, manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, technology of brewing process, equipments used for brewing and distillation, wine and related beverages, distilled spirits.

UNIT V PACKAGED DRINKING WATER
Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods of water treatment, BIS quality standards of bottled water; mineral water, natural spring water, flavoured water, carbonated water.

TOTAL: 45 PERIODS

TEXTBOOKS:
3. Priest FG & Stewart GG. 2006. Handbook of Brewing. 2nd Ed. CRC.

BASICS OF DRUG DESIGN

OBJECTIVES

- To enable the students to understand the basic concepts in drug design and to study the recent applications of computer aided drug design.

UNIT I INTRODUCTION
Sources of drugs and their chemistry, drug action-physiochemical properties, specificity, steric factors, conventional and rational strategies, lead optimisation and validation, structure activity relationship(SAR), electronic and quantum mechanical methods.
UNIT II  FUNDAMENTALS OF DRUG DESIGN  9
Intermolecular and intramolecular interaction, chirality, van der waals interaction, thermodynamic and stereochemical considerations, computer based drug design-structure (receptors), ligand based, prodrug based approaches.

UNIT III  MOLECULAR BASIS OF DRUG ACTION  9
Molecular recognition and binding-docking and simulation approaches, drug receptor interactions, pharmacodynamics and pharmacokinetics, target identification and validation, biochemical and cell based screens.

UNIT IV  COMBINATORIAL CHEMISTRY AND HIGH THROUGHPUT SCREENING  9
Different techniques, Solid phase synthesis, Solution phase synthesis, Parallel synthesis, applications of combinatorial chemistry. High Throughput Screening- general outline, importance and application

UNIT V  REGULATIONS IN DRUG DEVELOPMENT  9
New drug registration and development-IND and NDA application, patents act, IPR, Schedule Y, WTO and TRIPS, accreditation and harmonisation process.

TOTAL: 45 Periods

REFERENCES:

PM7792  PHARMACEUTICAL ADDITIVES  L T P C
3 0 0 3

OBJECTIVE
• To give an introductory knowledge on additive materials used in pharmaceutical formulations

UNIT I  INTRODUCTION TO FORMULATION AND INGREDIENTS  5
Definition of pharmaceutical dosage forms, classification of dosage forms and knowledge on routes of administration and their relative merits; pros and cons of various drug dosage forms and their types; definition of excipient/additive, the functional role of excipient – Relative versus absolute inactivity, the need for pharmaceutical additives, historical development in additives use

UNIT II  TYPES OF PHARMACEUTICAL ADDITIVES AND SELECTION  10
Overall classification of pharmaceutical additives listed below : Antiadherents, Binders, Coatings, Disintegrants, Flavors, Glidants, Lubricants, Sorbents, Preservatives, Sweeteners, Vehicles; Physico-chemical properties of additives and their selection according to dosage forms, ADME properties of additives.

UNIT III  DILUENTS, BINDERS, DISINTEGRATING AGENTS, LUBRICANTS AND GLIDANTS  10
Physico-chemical properties of the below and their application in formulation: Diluents – Lactose, Spray dried lactose, Starch, Microcrystalline cellulose, Dextrose, Sucrose; Binders – Acacia, Methyl cellulose, Gelatin, PVP, Starch paste, Tragacanth; Disintegrating Agents – Starch, Clays, Methyl cellulose, PVP cross linked alginates, Explotab; Lubricants – Stearic acid, Sodium stearate, Magnesium stearate, Talc, Poly ethylene glycols, Mineral oil; Glidants – Talc, Corn starch, Silica derivatives.
UNIT IV  SWEETENERS, PRESERVATIVES, COATING MATERIALS, FILM FORMERS, PLASTICIZERS,

Physico-chemical properties of the below and their application in formulation: Sweetening Agents – Sucrose, Glycerine, Glucose, Sorbitol, Sodium saccharin, Aspartame, Cyclamate; Preservatives – Phenol, Methyl paraben, Propyl paraben, Sodium benzoate, Chlorocresol, Thiomersal, Phenyl mercuric nitrate, Cetrimide, Enteric coating materials – Cellulose acetate phthalate, Acrylate polymer, Hydroxy propyl methyl cellulose phthalate, Polyvinyl acetate phthalate; Film Formers – Hydroxy methyl cellulose, Ethyl cellulose, HPC, MHEC, Povidone; Sodium CMC, Polyethylene glycol, Methyl acrylate; Plasticizers – Castor oil, Propylene glycol, Glycerine, Polysorbates, Miricyl palmitate.

UNIT V  OTHER MAJOR ADDITIVES AND OINTMENT BASES

Physico-chemical properties of the below and their application in formulation: Flavoring Agents; Viscosifying Agents; Emulsifying Agents; Surfactants; Wetting Agents; Flocculating agent; Antifoaming Agents; Propellants; Solvents; Sequestering Agents; Tonicity Modifiers; Ointment Bases; True Antioxidants ; Antioxidant synergists; Reducing Agents

OUTCOMES

- To provide knowledge pertaining to classification, terminologies and definitions various pharmaceutical components
- To imbibe essential information on the aspects of using the knowledge on additives to select and incorporate in pharmaceutical formulations

TOTAL: 45 PERIODS

TEXT BOOKS:


REFERENCES:

1. Remington, the science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins
3. Indian/British Pharmacopoeia