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

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
FACULTY OF CIVIL ENGINEERING								
DEPARTMENT OF CIVIL ENGINEERING								
B.E. Civil Engineering								
1.	CE7791	Project Formulation and Appraisal	OE	3	3	0	0	3
FACULTY OF MECHANICAL ENGINEERING								
DEPARTMENT OF MECHANICAL ENGINEERING								
B.E. Mechanical Engineering and B.E. Materials Sciences and Engineering								
2.	ME7791	Fundamentals of Ergonomic principles	OE	3	3	0	0	3
DEPARTMENT OF MANUFACTURING ENGINEERING								
B.E. Manufacturing Engineering								
3.	MF7791	Industrial and Bio-inspired Robotics	OE	3	3	0	0	3
DEPARTMENT OF PRINTING TECHNOLOGY								
B.E. Printing Technology								
4.	PT7791	Online Publishing	OE	3	3	0	0	3
B.E. Mining Engineering								
5.	MI7791	Mineral and their Exploration and Exploitation	OE	3	3	0	0	3
FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING								
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
B.E. Computer Science and Engineering								
6.	CS7791	Agile Methodologies	OE	3	3	0	0	3
7.	CS7792	Soft Computing	OE	3	3	0	0	3
DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY								
B.Tech. Information Technology								
8.	IT7791	Internet of Things	OE	3	3	0	0	3
FACULTY OF TECHNOLOGY								
DEPARTMENT OF CERAMIC TECHNOLOGY								
B.Tech. Ceramic Technology								
9.	CT7791	Refractory Engineering	OE	3	3	0	0	3
DEPARTMENT OF BIOTECHNOLOGY								
B.Tech. Industrial Biotechnology								
10.	IB7791	Biosensors	OE	3	3	0	0	3
11.	IB7792	Bioimaging	OE	3	3	0	0	3
B.Tech. Food Technology								
12.	FT7791	Food Equipment Design and Process Modelling	OE	3	3	0	0	3
13.	FT7792	Beverages Technology	OE	3	3	0	0	3
B.Tech. Pharmaceutical Technology								
14.	PM7791	Basics of Drug Designing	OE	3	3	0	0	3
15.	PM7792	Pharmaceutical Additives	OE	3	3	0	0	3

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

Project – Concepts – Capital Budgeting - Generation and Screening of Project Ideas - Project identification –Pre Feasibility Report and its Clearance - Project Estimates and Techno-Economic Feasibility Report- Detailed Project Report.

UNIT II PROJECT COSTING 9

Project Cash Flows – Time Value of Money – Cost of Capital.

UNIT III PROJECT APPRAISAL 9

NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal

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

Project Finance – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios – Public Private Partnership.

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:

1. Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation Review", McGraw Hill Publishing Company Ltd., 8th Edition, New Delhi. 2014.
2. Joy P.K., "Total Project Management - The Indian Context", New Delhi, Macmillan India Ltd., 2010.
3. Rajiv Srivastava, Anil Misra, “Financial Management”, Oxford University Press, 2nd Edition, New Delhi, 2015.

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

Design for standing workers – Design for seated workers – Design for repetitive task – Design for manual handling activity task – Design for work capacity, stress, and fatigue.

UNIT III ERGONOMICS IN EQUIPMENT DESIGN 9

Design for visual displays – Design for auditory displays – Design for controls – Design for virtual environments.

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

Human information processing, skill and performance – Human–computer interaction, memory and language – Human–machine interaction, human error and safety.

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:

1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and sons, New York, 2000
3. Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York, 1993.
4. McCormik, J., “Human Factors Engineering and Design”, McGraw Hill, 1992.
5. Martin Helander, “A guide to Human Factors and Ergonomics”, 2nd Edition, CRC, Taylor & Francis Group 2006.

MF7791 INDUSTRIAL AND BIO-INSPIRED ROBOTICS L T P C

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

Robotic system overview - Mechatronics - Anatomy of mechatronics systems - Actuator Systems - Sensors Systems - Control Systems, processors, controllers, open loop systems and closed loop systems.

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 9

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 9

Introduction - nature and robotics - biologically inspired designs vs. traditional technology - Animals vs. robots - Bio-Inspired Materials and Structures- Bio-Inspired Sensors- Muscle: Biomechanics vs. Artificial Muscle Actuators - case study.

UNIT V PRINCIPLES OF ANIMAL LOCOMOTION 9

Basic Physics of Locomotion: quantification and evaluation of nature - measurement of maneuverability and agility - Energy requirements for locomotion -Scaling effects - Locomotion on Ground - Crawling (warms, snakes, etc.) - Jumping - Walking - Running – Climbing - Flying - Gliding and Soaring - Hovering - Flapping Flight - Moving on the Surface of Water - Walking - Jumping - Running - Swimming - Oars and Hydrofoils - Undulation - Jet Propulsion– Mini Project.

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

1. W. Bolton, “Mechatronics – Electronic Control Systems in Mechanical and Electrical
2. Engineering”, Addison Wesley Longman Ltd., 2009.
3. Groover. M.P. “Industrial Robotics, technology, programming and application” Mc-Graw Hill book and co. 2012.
4. Principles of Animal Locomotion, R. McNeill Alexander, Princeton University Press, 2006
5. Animal Locomotion Physical Principles and Adaptations, Malcolm s. Gordon, Reinhardblickhan,
6. John o. Dabiri, John j. Videler, by taylor & francis 2017.

REFERENCES

1. Bio-mechanisms of Swimming and Flying: Fluid Dynamics, Biomimetic Robots, and Sports Science, edited by Naomi Kato and Shinji Kamimura, Springer Verlag, 2007 (ISBN 4431733795, 9784431733799).
2. Biomimetic Sensor Technology, Kiyoshi Toko, Cambridge University Press, 2000 (ISBN 0521593425, 9780521593427).
3. Biomimetics: Biologically Inspired Technologies, edited by Yoseph Bar-Cohen, CRC Press, 2005 (ISBN: 9780849331633).
4. Biomimicry for optimization, control, and automation, Passino, Kevin M., 2004.
5. Biomimicry: innovation inspired by nature, Benyus, Janine M., 1997.
6. Design homology: An Introduction to Bionics, Offner, David H., 1995.
7. Neurotechnology for Biomimetic Robots, edited by Joseph Ayers, Joel L. Davis, and Alan Rudolph, MIT Press, 2002 (ISBN: 0585437483, 9780585437484).

PT7791 **ONLINE PUBLISHING** **L T P C**
3 0 0 3

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: Copy-right - 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:

1. William E. Kasdorf, “The Columbia Guide to Digital Publishing”, Columbia University Press, 2003.
2. David Bergsland , “Introduction to Digital Publishing, Volume 1” Cengage Learning, 2002

REFERENCES

1. Joanna Penn “On Writing, Publishing, Book Marketing and Creative Entrepreneurship” Feb 2015 Edition
2. Gunter Born “The File Formats Handbook” published by International Thomson Computer Press, 1997.
3. Frania Hall, “The Business of Digital Publishing: An Introduction to the Digital Book and Journal Industries”, Routledge, 2013

MI7791 MINERAL AND THEIR EXPLORATION AND EXPLOITATION L T P C
3 0 0 3

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 9

Introduction to mineral exploration and mining industry, National Mineral Policy, 2008, Classification of Mineral Deposits, Importance of mineral & mining industry in national growth, Economic Mineral Deposits and Host Rocks. Mineral Sampling Equipment, Sampling Methods, Sample Reduction for Chemical Analysis, Accuracy and Due Diligence in Sampling, Quality Assurance and Quality Control, Optimization of Samples.

UNIT II EXPLORATION GEOLOGY 9

Regional Planning and Organization, Topographic Survey, Geological Mapping, Stratigraphic Correlation, Exploration Geochemistry, Field Procedure, Analytical Methods, Data Interpretation, Geochemical Methods, Exploration Geophysics, Seismic Survey, Gravity Survey, Magnetic Survey, Electrical Survey, EM Survey, Radiometric Survey, Borehole Logging. Mineral Resource and Ore Reserve Estimation, Estimation of Quality, Conventional Resource/Reserve Estimation, Mineral Resource and Ore Reserve Classification, Ore Monitoring System

UNIT III SURFACE MINING 9

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 9

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 9

Allocation of jurisdiction over minerals and mines under the Constitution Minor minerals and other minerals; National Mineral and Exploration Policy, 2016. Overview of laws: Indian Mines Act, 1952; Mines and Minerals (Development and Regulation) Act, 1957; Mineral Conservation and Development Rules, 2017, Minerals (Evidence of Mineral Contents) Rules, 2015; Atomic Energy Act, 1962; Proprietary rights over minerals: Articles 294 and 297 Coal; Mineral Concession Rules, 1960; Powers of Central and State Governments; Reconnaissance permit, Prospecting and Mining licenses/lease, Composite License: Duration, termination etc. Method of grant of license: Auctions Amendments to the MMDR Act Captive mines. Environmental laws and their applicability to the mining sector, Water and Air Pollution, EIA, Forest and Wildlife Clearance.

TOTAL: 45 PERIODS

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.

TEXT BOOKS:

1. Haldar, S. K., Mineral Exploration Principles and Applications, Elsevier, First Edition, 2013.
2. Moon C J., Whateley M K.G. & Evans A M., Introduction to Mineral Exploration, Blackwell Publishing, Second Edition, 2012.

REFERENCES:

1. Hartman, H. L. (Editor), SME Mining Engineering Handbook, 3rd edition, Vol I & II, Society of Mining Engineers, New York, 2011.
2. Deshmukh,D.J., Elements of Mining Technology, Vol.I & II , Vidyaseva Prakashan, Nagpur, 1994.
3. Wills, B.A. & Finch, J., Wills' Mineral Processing Technology - An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery, Butterworth-Heinemann, 8th Edition, 2015.

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 9

Theories for Agile Management –Agile Software Development –Traditional Model vs. Agile Model - Classification of Agile Methods –Agile Manifesto and Principles –Agile Project Management –Agile Team Interactions –Ethics in Agile Teams -Agility in Design, Testing –Agile Documentations –Agile Drivers, Capabilities and Values

UNIT II AGILE PROCESSES 9

Lean Production -SCRUM, Crystal, Feature Driven Development-Adaptive Software Development -Extreme Programming: Method Overview –Lifecycle –Work Products, Roles and Practices.

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT 9

Agile Information Systems –Agile Decision Making -Earl S Schools of KM –Institutional Knowledge Evolution Cycle–Development, Acquisition, Refinement, Distribution, Deployment, Leveraging –KM in Software Engineering –Managing Software Knowledge –Challenges of Migrating to Agile Methodologies –Agile Knowledge Sharing –Role of Story-Cards –Story-Card Maturity Model (SMM).

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING 9

Impact of Agile Processes in RE–Current Agile Practices –Variance –Overview of RE Using Agile –Managing Unstable Requirements –Requirements Elicitation –Agile Requirements Abstraction Model –Requirements Management in Agile Environment, Agile Requirements Prioritization –Agile Requirements Modeling and Generation –Concurrency in Agile Requirements Generation.

UNIT V AGILITY AND QUALITY ASSURANCE 9

Agile Product Development –Agile Metrics –Feature Driven Development (FDD) –Financial and Production Metrics in FDD –Agile Approach to Quality Assurance -Test Driven Development – Agile Approach in Global Software Development, Case studies.

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:

1. David J. Anderson and Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for business Results‖, Prentice Hall, 2003.
2. Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

REFERENCES:

1. Craig Larman, —Agile and Iterative Development: A Manager‟s Guide‖, Addison-Wesley, 2004.
2. Kevin C. Desouza, —Agile Information Systems: Conceptualization, Construction, and Management‖, Butterworth-Heinemann, 2007.

CS7792 SOFT COMPUTING L T P C

3 0 0 3

UNITI 9

Introduction – Intelligent Agents – Characteristics –Types of Intelligent Agents – Agents & Environments – Search strategies: Uninformed Search: BFS, DFS - Informed Search: Hill Climbing, Simulated Annealing – Pattern Recognition

UNIT II 9

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 III 9

Evolutionary Computing – Genetic Algorithm – Genetic Representation – Initialization and Selection – Genetic Operators – Mutation – Generational Cycle – Applications

UNIT IV 9

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

UNIT V 9

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.
2. S. Russel and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd edition, 2009
3. Tom Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
4. S. Haykin, Neural Networks: A Comprehensive Foundation, 2nd Ed, Pearson Education, 1999
5. Stephen Marsland, Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

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 9

Evolution of Internet of Things - Enabling Technologies – Machine to Machine Communication-– Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS 9

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 9

Design Methodology - Embedded computing logic - Microcontroller, Zigbee and RFID - Arduino - IDE programming - Raspberry Pi - Interfaces and Python Programming in Raspberry Pi-Web Services.

UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES 9

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 9

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 Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

TEXTBOOK:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O’Reilly Media, 2011.

https://www.arduino.cc/

https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

CT7791 REFRACTORY 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, Si_3N_4, 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 8

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 REFRACTORY APPLICATIONS IN METALLIC INDUSTRIES 9

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.

TOTAL: 45 PERIODS

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

1. D.N.Nandi, Handbook of Refractories, Tata McGraw Hill Publishing Co, New Delhi,1991
2. Shaw K, Refractories & Their Uses, App. Science Publishers, UK,1972
3. Chester, J.H. Refractories, Production and Properties, 1973, Iron and Steel Institute, London.
4. Handbook of Monolithics, 1980, Plibrico, Japan.
5. Charless.A.Schacht, Refractories Handbook, 2007, Marcel Dekkar Publications.
6. Ritwik Sarkar, Refractory Technology: Fundamentals and Applications, 2017, CRC Press
7. C. A. Schacht, Refractory Linings: Thermo-mechanical Design and Applications, 1995, CRC Press.

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 biologicalmolecules.

UNIT I FUNDAMENTALS OF BIOSENSORS 9

Biosensors as Functional Analogs of Chemoreceptors, Structure and Function of Transducers, Thermometric Indication with Thermistors, Optoelectronic Sensors, Piezoelectric Sensors, Electrochemical Sensors, Potentiometric Electrodes, Amperometric Electrodes, Conductometric Measurement.Immobilization of the Receptor Component in Biosensors, Methods of Immobilization:Adsorption, Gel Entrapment, Covalent Coupling, Crosslinking. Immobilization Effects inBiosensors, Characterization of Immobilized Enzymes in Biosensors, Recovery of Enzyme Activity, Effectiveness Factor, Enzyme Loading Test, Linear Measuring Range,pH Dependence, Temperature Dependence

UNIT II TYPES AND DETECTION METHODS 9

Protein/antibody-based sensors: protein immobilisation, specificity, binding constants, kinetics, diffusion, Enzymatic biosensors, immunobiosensors, DNA based biosensors, cell based biosensors, and Electrochemical and optical sensors/transducers. Potentiometric methods. Redox-enzymes in amperometric methods. Conductimetric methods.

UNIT III METABOLISM SENSORS 9

Glucose Sensors, Galactose Sensors, Enzyme Electrodes for Gluconate, Lactate Sensors, Pyruvate Sensors, Determination of Alcohols, Sensors for Phenols and Amines, Cholesterol Sensors, Determination of Bile Acids, Determination of Uric Acid, Determination of Ascorbic Acid (Vitamin C), Nitrite and Nitrate, Carbon Monoxide. Electrochemical Sensor for Hydrogen Determination, Sensors for Amino Acids, Urea Sensors, Creatinine Sensors, Penicillin Sensors, Determination of Glycerol and Triglycerides, Biosensors Using Coupled Enzyme Reactions, Enzyme Sequence Sensors for Phosphatidylcholines and Acetylcholine, Multienzyme Electrodes for Nucleic Acid Compounds,

UNIT IV AFFINITY BIOSENSORS 9

Affinity Sensors Using Low-Molecular Weight Ligands, Affinity Sensors Based on Proteins and Enzymes, Binding Sensors, Enzyme Sensors for Inhibitors, Immunosensors, Principles of Immunoassays, Electrode-Based Enzyme Immunoassays, Immunoreactors, Thermometric Enzyme Immunoassays, Membrane Immunosensors, Piezoelectric Systems, Optical Immunosensors, Biosensors Using Intact Biological Receptors, Apoenzyme Electrodes for the Determination of Prosthetic Groups, Immunoreactors with Electrochemical Detection. Biomimetic sensors

UNIT V APPLICATIONS AND FUTURE AVENUES 9

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

1. “Chemical Sensors and Biosensors: Fundamentals and Applications”, F.-G. Bănică, Wiley, 2012
   This text book is on reserve, and it is also available from UR library online resources.
2. “Electrochemical Methods: Fundamentals and Applications”, 2nd Ed., A.J. Bard, L.R. Faulk ner, Wiley, 2001
3. *Eggins, Brian R.* Chemical sensors and biosensors. New York: John Wiley, 2002

REFERENCE

1. Handbook of fluorescence spectroscopy and imaging (M. Sauer, J. Hofkens, J. Enderlein)
2. Single molecule spectroscopy in chemistry, physics, and biology (A. Gräslund, R. Rigler, J. Widengren)

IB7792 **BIOIMAGING** **L T P C**
3 0 0 3

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 **9**

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 **9**

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 **9**

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 **9**

Radiography: X-rays use and detection. Fluoroscopy. Projectional vs tomographic images. CT ["TAC"] scanners. MicroCT (&MRI). Magnetic Resonance Imaging. Radiation sources in medical imaging, and nuclear medicine. Gamma cameras (Scintigraphy). PET - Positron Emission Tomography , MRI - Virtual surgery and diagnostics. Ultrasonography (3D and 4D). In vivo (whole animal) molecular imagers. Thermal and NIR imaging in medicine. 3D image capture and visualization techniques in biology; The visible human project. Tomography and anatomical planes, X-ray computerized tomography, nuclear tomographic imaging, single photon emission computedtomography

UNIT V PHYSICS AND TECHNOLOGY **9**

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.

TOTAL: 45 PERIODS

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.)

REFERENCE;

1. Handbook of fluorescence spectroscopy and imaging (M. Sauer, J. Hofkens, J. Enderlein)
2. Single molecule spectroscopy in chemistry, physics, and biology (A. Gräslund, R. Rigler, J. Widengren)

FT7791 FOOD EQUIPMENT DESIGN AND PROCESS MODELLING L T P C
3 0 0 3

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

Design of Food Processing equipment: Dryers, design of dryers, PHTC, RPEC, LSU and Drum Dryer. Determination of heat and air requirement for drying grains. Design of storage vessels for liquid food and grains. Design of material handling equipment like belt conveyor, screw conveyor, bucket elevator and pneumatic conveyors Pressure vessels design and design of vessel for drum drying. Performance characteristics and selection of fans, blowers, ejector compressors and vacuum pumps. Design of heat exchange equipment-plate, scraped surface and extended surface for heating and cooling of gas and liquid.

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

Key principles and methods of kinetic modelling, areas of application, pros and cons of kinetic modelling, deductive and inductive modelling: process optimization, modelling the keeping quality and shelf life of foods, modelling food processes, benefits for modelling food processes. Modelling and prediction of uncertain environment.

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

Modelling thermal processes: cooling and freezing, introduction Modelling product heat load during cooling & freezing. Modelling foods with complex shapes, numerical solution of the heat conduction equation with phase change. Modelling thermal processes: heating, introduction, processing of packed and solid foods, continuous heating and cooling processes.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. Joshi, M. V. and Mahajan, V. V. Process Equipment Design, (Macmillan India Ltd., 2000)
2. Walas, S. M. Chemical Process Equipment, selection and Design, (Butterworth-Heinemann, 2009)
3. Denn M. M., "Process Modeling", Longman, 1986.

REFERENCES

1. Brownell, L. E. and Young, E. H. Process Equipment Design - Vessel Design, (Wiley Eastern Edn., 1968)
2. Ahmad, T. Dairy Plant Engineering and Management, (Kitab Mahal, 2009)

FT7792 BEVERAGES TECHNOLOGY L T P C
3 0 0 3

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 9

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 9

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 9

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 9

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 9

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;

1. Hardwick WA. 1995. Handbook of Brewing. Marcel Dekker.
2. Hui YH et al 2004. Handbook of Food and Beverage Fermentation Technology. Marcel Dekker.
3. Priest FG & Stewart GG. 2006. Handbook of Brewing. 2nd Ed. CRC.
4. Richard PV. 1981. Commercial Wine Making - Processing and Controls. AVI Publ.
5. Varnam AH & Sutherland JP. 1994. Beverages: Technology, Chemistry and Microbiology. Chapman & Hall.
6. Woodroof JG & Phillips GF.1974. Beverages: Carbonated and Non-Carbonated. AVI Publ.

PM7791 BASICS OF DRUG DESIGN L T P C
3 0 0 3

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 9

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, vander 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;

1. BMC – Burger's Medicinal Chemistry and Drug Discovery, 5th Edition, Vol. 1. Principles and Practice, edited by M. E. Wolff, John Wiley & Sons: New York, 1995.
2. A Practical Guide to Combinatorial Chemistry, edited by A. W. Czarnik and S. H.DeWitt, American Chemical Society: Washington DC, 1997.
3. New Drug Development: A Regulatory Overview. Edited by Mark P. Mathieu and William J. Murphy Ill. OMEC International,Inc., Washington, DC. 1987.
4. Textbook of Drug Design and Discovery, Povl Krogsgaard-Larsen, Ulf Madsen, Kristian Stromgaard, 4th Edition, 2009. Taylor and Francis.

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, 10

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 10

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;

1. Lachman, Leon et al. “The Theory and Practice of Industrial Pharmacy” 3rd Ed., Varghese Publishing House, 1987
2. Carter, S.J. “Cooper and Gunn’s Tutorial Pharmacy, 6th Edition. CBS Publishers, 1986.
3. Aulton, Michael E. “Pharmaceutics: The Science of Dosage Form Design” 2nd Ed., Churchill Livingstone, 2002
4. Allen, Loyd V. et al. “Ansel’s Pharmaceutical Dosage Forms and Drug Delivery Systems” 9th Ed., Wolters Kluver/Lippin Cott Williams & Wilkins, 2011.
5. H. A. Liberman,, L. Lachman, and J. B. Schwartz: Pharmaceutical dosage forms: Tablets, Vol. 1,2 and 3, 2nd Edition Marcel Dekke r, 1989

REFERENCES:

1. Remington, the science and practice of pharmacy, 21st Edition, Lippincott Williams and Wilkins
2. Monihan, Humphery and Abina Gean “The Physicochemical Basis of Pharmaceuticals” Oxford University Press, 2009
3. Indian/British Pharmacopoeia