CBCS COURSE STRUCTURE AND SYLLABI

B-Tech

(Phytopharmaceuticals)

2022-2023

Centurion UNIVERSITY

Shaping Lives...
Empowering Communities...

Department of Phytopharmaceuticals
School of Agricultural and Bio-Engineering (SoABE)
CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
Odisha-761211, INDIA,

Web Site: - www.cutm.ac.in

Program Objective

Phytopharmaceuticals is a new evolution of herbal pharmaceuticals and natural supplement industry, for developing quality health care products from herbs. With mutual collaboration with Herbal Industries Centurion University of Technology & Management, Paralakhemundi campus, offers a new undergraduate program in Phytopharmaceuticals under the School of Agriculture & Bioengineering. Major objective of the program Bachelor of Phytopharmaceutical Technology is to imbibe necessary skill sets in the students so that they become well versed in the Herbal science, R&D, Quality Assurance, Supply chain management, production, drug dosage forms, functional foods, organic natural cosmetics, Agriculture and process engineering etc.

Objectives

1. To provide deep knowledge in medicinal plants, natural herbal product formulations and Phytopharmaceutical products.
2. To develop required skill sets of phytopharmaceuticals in the students pursing this program.
3. To generate employment in Herbal Pharmaceutical Industries such as Himalaya, Dabur, Emami, Patanjali etc
4. To transform pupil with enthusiasm into innovators who can design the products for the wellness of our society.

Program Specific Objective

Centurion University of Technology & Management in collaboration with Herbal Industries designed this program curriculum which amalgamates the knowledge of ancient herbal science & modern Engineering Technology. Department of Phytopharmaceuticals has been established in the year 2019 under SoABE. Through this course we aim to create the necessary trained and skilled personnel as per the requirements of the industry which will benefit academia, students and industrial sectors. This unique program is enriched with Advisory Board which provides necessary support in Field visits, Industrial tours, Workshops, Internships and in plant training in reputed government and private herbal industries which will hone specific skills precisely necessary for students of this program for prospering in their future career.

Objectives

1. Students qualified in this course will have good placement opportunities in Q.C, Q.A, R&D, Manufacturing, Production & Supply chain units, Regulatory affairs, Marketing sectors of herbal pharmaceutical industries.
2. Beyond the conventional employment in major functional arenas of Phytopharmaceutical industries pupil who graduated in this program can also flourish as organic supplier of herbal materials, freelance consultant, IPR and Regulatory affairs specialist in Herbal & Ayurvedic sectors, retailer or wholesale market manager of phytopharmaceutical products etc.
3. This program enables and encourages in establishing a start up which will lead to the development of new entrepreneurs from ever growing, ever green and ever evolving Phytopharmaceutical Industry.

BASKET STRUCTURE

Basket		**Basket Category**	**Minimum Credits to be acquired**	**Scope**
I		Foundation Courses in Sciences	17	Choice
II		Foundation Courses in Humanities & Management	12	Choice
III		Smart Stack	25	Core
IV	IV.A	Foundation Engineering Courses	51	Core
	IV.B	Core Engineering Courses	41	Core
	IV.C	Summer Training one month (2*3)	6	Core
V		Domain Courses, Industrial Internship	28	Choice
		Total Credits	180	

Basket I: Foundation courses in Sciences

Sl. No	Area	Code	Course	T	Pr	Pj
1	Math(5)	CUTM1001	Differential Equations and Laplace Transformation	2	0	1
2		CUTM1002	Linear Algebra & Vector Calculus	2	0	1
3		CUTM1003	Complex Analysis, Numerical Methods	2	0	1
4		CUTM1004	Discrete Mathematics	2	0	1
5		CUTM1005	Probability & Statistics	2	0	1
7	Physics(2)	CUTM1006	Mechanics for Engineers	2	1	0
8		CUTM1007	Optics and Optical Fibres	2	1	0
9	Chemistry(2)	CUTM1008	Applied Analytical Chemistry	2	1	0
10		CUTM1009	Applied Engineering Materials	2	0	1
11		CUTM1010	Environmental Studies	0	0	2

Basket II: Humanities and Management

Area	Code	Course	T	Pr	Pj
Management	CUTM1011	Optimisation Techniques	0	2	0
	CUTM1012	Engineering Economics and Costing	2	0	1
	CUTM1013	Project Management	2	0	1
Sustainable	CUTM1014	Gender, Human Rights and Ethics	1.5	0	1.5
	CUTM1015	Climate Change, Sustainability and Organisation	1.5	0	1.5
	CUTM1016	Job readiness	0	6	0

Basket III: Smart Stack

Sl. No	Code	Course	T	Pr	Pj
1	CUTM1017	Industrial IOT and Automation	3	2	1
2	CUTM1018	Data Analysis and Visualisation using Python	1	1	2
3	CUTM1019	Machine Learning using Python	1	2	1
4	CUTM1020	Robotic automation with ROS and C++	1	2	1
5	CUTM1021	Design Thinking	0	0	2
6	CUTM1022	System Integration with DYMOLA	0	0	2
7	CUTM1023	Smart Engineering Project (G2M)	0	0	3
		Total	**6**	**7**	**12**

Basket IV: Core Course

Sl	Code	Course	Credits	
			T+Pr+Pj	
	Basket IV A			
1	CUTM1079	Manufacturing Process-process planning and Heat Treatment	2+1+0	3
2	CUTM1075	Computer Aided Drafting	0+2+1	3
3	CUTM1088	Thermodynamics	2+1+0	3
4	CUTM1046	Electronic Devices Systems & Applications	2+1+0	3
5	CUTM1057	Basic Electrical Engineering	1+1+0	2
6	CUTM1708	Human Anatomy and Physiology	2+1+0	3
7	CUTM1588	Industrial Pharmacy-II	4+0+0	4
8	CUTM1525	Heat Transfer	2+0+1	3
9	CUTM2330	MEDICINAL AND AROMATIC CROPS I	2+1+0	3
10	CUTM2331	MEDICINAL AND AROMATIC CROPS II	2+1+0	3
	Basket IVB			
1	CUTM1167	Pharmacognosy and phytochemistry of Important medicinal herbs	2+1+1	4
2	CUTM1169	Regulations & Certifications of Herbal Drugs	3+0+1	4
3	CUTM1170	Material Science of Excipients and Additives	2+0+1	3
4	CUTM1171	Pharmacology- Phyto	2+1+1	4
5	CUTM1172	Advanced separation technologies and downstream processing	2+1+1	4
6	CUTM1173	Packaging Technologies	2+0+1	3
7	CUTM1174	Bioanalytical techniques	2+1+1	4
8	CUTM1168	Ayurveda and fermentation technology	2+1+0	3
9	CUTM1175	Herbal Cosmetic Technology	2+0+2	4
10	CUTM1176	Quality Assurance and Quality Control of Herbal Products	2+0+1	3
11	CUTM1179	Plant Design and Operation for Herbal Drugs	2+0+1	3
12	CUTM1180	Statistical Quality Control & Design of Experiments	2+0+1	3
13	CUTM1177	Plant Biotechnology	2+1+1	4
14	CUTM1178	Good Manufacturing Practices-Herbal Industry	2+0+2	4

Course Syllabus for Basket-I

Differential Equations and Laplace Transforms [**CUTM1001 (2-0-1)]**

Course Objectives

• Introduce students to how to solve linear Differential Equations with different methods

• Introduce the concepts of Laplace transforms

• The goals for the course are to gain a facility with using the transform, both specific techniques and general principles.

• Introduce students how to solve first order and second order differential equations

Course Outcomes

Upon successful completion of this course, students will be able to:

• Understand the importance of linear functions in mathematics.

• Learn using Laplace transform to solve differential equations

• Understand the major problems of differential and Laplace Transforms

• Learn fundamental concepts of ODE theories and where and how such equations arise in applications to scientific and engineering problems.

• Be competent in solving linear/non-linear 1st & higher order ODEs using analytical methods to obtain their exact solutions

Course Syllabus

Module-I:

First order linear differential equations and its applications

Project-1: Some applications of differential equations in RL-RC electrical circuit problems

Module-II:

Second order linear homogeneous differential equations (Real roots, Real equal roots, Complex conjugate roots) and its applications.

Project-2: RLC Circuit, Pendulum

Module-III:

Second order linear non-homogeneous differential equations, Finding particular integral consisting of exponential, trigonometric (Sine, cosine) using inverse operator method

Project-3: Simple mass-spring system, Damped vibration system

Module-IV:

Laplace transforms, First shifting theorem, Applications of first shifting theorem

Module-V:

Inverse Laplace transforms, Inverse Laplace transforms of first shifting theorem

Module-VI:

Transforms of Derivatives Differential equations, Differential Equations, Initial value problems.

Project 4: Laplace transform of the integral of a function

Module-VII:

Unit step Function, Second shifting theorem

Project 5: Dirac's Delta function

Project 6: Application of Unit step function (RC- Circuit to a single square wave)

Text Books:

1. Advanced engineering mathematics by Erwin Kreyszig, 9th edition
2. Higher Engineering by B.V. Ramana
3. Differential Equations by Jeffrey R. Chasnov

Reference Books:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi.
2. G.B. Thomas, M.D. Weir, J.R. Hass, Thomas' Calculus, Pearson Publication.
3. R.G. Bartle, D.R. Sherbert, Introduction to Real Analysis, Wiley Publication

Linear Algebra and Vector Calculus [CUTM1002 (2-0-1)]

Course Objectives

• To find the kernel, range, rank, and nullity of a linear transformation.

•To solve the system of linear equations appearing in the problems of electrical engineering, mechanical engineering etc.

• To use Eigen values and Eigen vectors in Control theory, vibration analysis, electric circuits, advanced dynamics

problems.

Course Outcomes

Upon successful completion of this course, students will be able to:

•Explain the concepts of base and dimension of vector space.

•Solve systems of linear equations using Gauss- elimination to reduce to echelon form.

Course Syllabus

Module I: (4hrs+2hrs)

Basic concepts of a matrices, solution of linear system of equations by Gauss elimination method, linearly independent and dependent of a vectors, rank of a matrix.

Project-1(2hrs)

Report on finding the traffic flow in the net of one-way streets

Module II: (3hrs)

Determinants and Cramer's Rule, Fundamental theorem of linear system of equations.

Project-2(2hrs)

Find the respective currents flowing through an electrical network using Kirchhoff current law.

Module III: (3hrs)

Eigenvalues and Eigen vectors.

Project-3(2hrs)

(i)Find the limit states of the Markov process model. (ii)Find the growth rate in the Leslie model

Module IV: (2hrs)

Symmetric, Skew-Symmetric and Orthogonal Matrices.

Project-4(2hrs)

To make a report to show that the product of two orthogonal matrices is orthogonal, and so is the inverse of an orthogonal matrix. What does this mean in terms of rotations?

Module V: (2hrs)

Complex matrices, Hermitian, skew-Hermitian, and Unitary Matrices.

Project-5(2hrs)

To make a report on simple matrix that is not normal. Find a normal matrix that is not Hermitian, skew-Hermitian, or unitary, Justify.

Module VI: (3hrs)

Inner Product (Dot Product) , Vector Product (Cross Product),Triple Scalar Product. Vector and Scalar Functions.

Module VII: (3hrs)

Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Project-6(2hrs)

Summary on Grad, Div, Curl. List the definition and most important facts and formulas for grad, div, curl, and . Use your list to write a corresponding essay of 3-4 pages. Include typical examples of your own.

Text Books:

1. E. Kreyszig , Advanced Engineering Mathematics, Johnwilley & Sons Inc-8th Edition.Chapters:6(6.1 to 6.7),7 (7.1,7.3 and 7.4(definitions only , no proofs)),8(8.2 to 8.4,8.7 to 8.9)

2. Highjer Engineering Mathematics by B.V.Ramana, Tata McGraw-Hill Education India, Inc-8th Edition.

Reference Books:

1) Advanced Engineering Mathematics by P.V.O' Neil
Publisher: Thomson

2) Mathematical Methods by Potter & Goldberg ; Publisher : PHI

Complex Analysis & Numerical Methods [CUTM1003 (2-0-1)]

Course Objectives

- To understand about Complex variables and complex functions.
- To acquire the skill of evaluating contour integrals using Cauchy's integral formula and Cauchy's integral theorem.
- To understand the limitations of analytical methods and the need for numerical methods and the ability to apply these numerical methods to obtain the approximate solutions to engineering and mathematical problems.

Course Outcomes

Upon successful completion of this course, students will be able to :

- To get equipped with the understanding of the fundamental concepts of functions of a complex variable along with the concepts of analyticity, Cauchy-Riemann relations and harmonic functions.
- Evaluate complex contour integrals applying the Cauchy integral theorem, Cauchy integral formula.
- Derive a variety of numerical methods for finding out solutions of various mathematical problems arising in roots of linear and non-linear equations, solving differential equations with initial conditions and Evaluating real definite integrals.

Course Syllabus

Module I (T-3 hrs-P-0-hrs-P-0 hrs)

Complex numbers, Algebra of complex numbers, Modulus and argument, Functions of a complex variable.

Module II (T-4 hrs-P-0 hrs-P-2 hrs)

Analytic functions, Cauchy-Riemann equations (Without Proof), Harmonic and Conjugate harmonic functions.

Project-1: Verification of Cauchy-Riemann equations for complex functions in Cartesian form and Polar form

Module III (T-3 hrs-P-0 hrs-P-2 hrs)

Complex integrals, Cauchy's Integral Theorem (Without Proof), Cauchy's Integral Formula (Without Proof), Cauchy's Integral Formula for higher order derivatives (Without Proof).

Project-2: Evaluation of contour integrals using Cauchy's Integral Formula

Module – IV (T-2 hrs-P-0 hrs-P-2 hrs)

Interpolation, Lagrange interpolation polynomial.

Project-3: Finding out the value of a given function at an interior point on an unequal interval using Lagrange interpolation polynomial

Module – V (T-3 hrs-P-0 hrs-P-2 hrs)

Forward and backward difference operators, Newton's forward and backward difference Interpolation formulae.

Project-4: Finding out the value of a given function at an interior point on an equal interval using Newton's forward and backward difference interpolation formulae

Module – VI (T-2 hrs-P-0 hrs-P 2 hrs)

Numerical Integration, Trapizoidal rule, Simpson's one third rule.

Project-5: Evaluation of real definite integrals using Trapizoidal rule and Simpson's one third rule

Module – VII (T-3 hrs-P-0 hrs-P-2 hrs)

Runge-Kutta 2nd & 4th order methods.

Project-6: Finding out Numerical solutions of differential equations using Runge-Kutta 2^{nd} & 4^{th} order methods

Text Book

1) Advanced Engineering Mathematics by E. Kreyszig Publisher: Johnwilley & Sons Inc-8th Edition Chapters: 12 (12.1 to 12.4), 13 (13.1 to 13.4)

Reference Books:

1) Advanced Engineering Mathematics by P.V. O'Neil Publisher: Thomson

2) Fundamentals of Complex Analysis (with Applications to Engineering and Science) by E.B. Saff & A.D. Snider Publisher: Pearson

Text Book:

1) Advanced Engineering Mathematics by E. Kreyszig

Publisher: John Willey & Sons Inc-8th Edition Chapters: 17 (17.3, 17.5), 19 (19.1)

Reference Books:

1) Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar & R.K. Jain; New Age International Publishers.

2) Introductory Methods of Numerical Analysis by S.S. Sastry; Third Edition, Prentice Hall India.

Discrete Mathematics [CUTM1004 (2-0-1)]

Course Objectives:

To understand mathematical reasoning in order to read, comprehend and construct Mathematical arguments as well as to solve problems, occurred in the development of programming languages.

To work with discrete structures such as graphs to study the structure of the world wide web, to model a computer network and to find the shortest path between two places in a transportation network.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

Apply the logical structure of proofs and work symbolically with connectives and quantifiers to produce logically valid, correct and clear arguments.

Evaluate elementary mathematical arguments and identify fallacious reasoning

Reformulate statements from common language to formal logic. Apply truth tables and the rules of propositional and predicate calculus.

Model and solve real-world problems using graphs, both quantitatively and qualitatively.

Course Syllabus

MODULE-I(4 Hours)

Propositional Logic, Connectives, Truth tables of compound propositions, Propositional Equivalence.

Project 1: Given the truth values of the propositions *p* and *q*, find the truth values of the conjunction, disjunction, implication, bi-implication, converse, contrapositive and inverse.

MODULE-II (3 Hours)

Theory of inference, Predicates and Quantifiers, Rules of Inference.

Project 2: Build valid arguments of a given set of propositional logics and quantified statements using rules of inferences.

MODULE-III (3 Hours)

Relations and its properties, Partial Ordering, POSET, Totally Ordered Set.

Project 3: Define the properties of a relation on a set using the matrix representation of that relation with examples.

MODULE-IV (3Hours)

Hasse Diagram, Maximal & Minimal Elements of a Poset, Greatest & Least Elements of a Poset, Supremum & Infimum of a Poset, Lattice.

Project 4: Find a Topological Sort of a Poset.

MODULE-V (3 Hours)

Introduction to Graph Theory, Graph Terminology and Special types of Graphs, Representation of Graphs.

Project 5: Describe how some special types of graphs such as bipartite, complete bipartite graphs are used in Job Assignment, Model, Local Area Networks and Parallel Processing.

MODULE-VI (3 Hours)

Graph Isomorphism, Connectivity, Euler and Hamiltonian Graphs, Planar Graphs, Graph Coloring.

Project 6(i): Describe the scheduling of semester examination at a University and Frequency Assignments using Graph Coloring with examples. Find also their Chromatic numbers.

Project 6(ii): List out 10 pairs of Non-isomorphic graphs and explain the reason behind it.

Project 6(iii): List out all features ofEuler and Hamiltonian Graphs. Justify whether the given set of graphs are Euler and Hamiltonian. Construct a Gray Code where the code words are bit strings of length three.

MODULE-VII (4 Hours)

Trees and their Properties, Spanning Trees, Minimum Spanning Trees, Kruskal's Algorithm.

Project 7: Find a minimum spanning tree in a given weighted graph using Kruskal's Algorithm.

Text Books:

Discrete Mathematics and its Applications by K.H.Rosen, Publisher: TMH, Sixth Edition, 2009. Chapters: 1(1.1 ,1.2,1.3, 1.5); 7(7.1,7.6); 8(8.1 to8.5, 8.7, 8.8);9(9.1,9.4,9.5)

Reference Books:

Discrete Mathematical Structures with Applications to Computer Science, J. P. Trembkay, Manohar, Tata MC Graw – Hill Edition 38th reprint, 2010.

Discrete and Combinatorial Mathematics by R.P. Grimaldi Publisher: Pearson, 5th Edition, 2003.

Discrete Mathematics and Applications by Thomas Koshy Publisher: Elsevier, 2004.

Discrete Mathematical Structures by B. Kolman, R.C. Busby & S. Ross Publisher: PHI, 5th Edition, 2003.

Probability and Statistics [**CUTM1005 (2-0-1)]**

Course Objectives

•To translate real-world problems into probability models

•To motivate students in an intrinsic interest in statistical thinking

•To apply probability and statistics in engineering and science like disease modeling, climate prediction and computer networks etc.

Course Outcomes

Upon successful completion of this course, students will be able to:

• Define and illustrate the concepts of sample space, events and compute the probability and conditional probability of events.

• Define, illustrate and apply the concepts of discrete and continuous random variables, the discrete and continuous probability distributions.

• Define, illustrate and apply the concept of the expectation to the mean, variance and covariance of random variables.

• Compute probabilities based on practical situations using the Binomial, Poisson and Normal distributions.

Course Syllabus

Module I:(3 hrs+2 hrs)

Sample spaces and events; axiomatic definition of probability; Axioms of Probabilities

Project-1

A Report on Application of probability to control the flow of traffic through a highway system, a telephone interchange, or a computer processor

Module II:(3 hrs +2 hrs)

Mutually Exclusive Events, Dependent and Independent Events. Conditional Probability

Project-2

A Report on Dependent and Independent Events with Examples

Module III:(3 hrs +2 hrs)

Discrete random variables and probability distributions, Continuous random variables and probability

distributions , Mean ,Variance and Moment Generating Function of Distributions

Project-3

Application of random variables in Engineering Field

Module IV:(3 hrs +2 hrs)

Uniform Distribution, Binomial Distribution, Poisson Distribution

Project-4

Applications of Poisson distribution

Module V:(3 hrs +2 hrs)

Normal Distribution, Working with Normal Tables, Normal Approximation to the Binomial Distributions

Project-5

Normal Distribution utilized in statistics, business settings, and government entities.

Module VI:(3 hrs)

Statistics: Random Sampling, Population and Sample, Sample Mean and Variances, Point and Interval Estimations, Confidence Intervals

Module VII:(3 hrs +2 hrs)

Regression and Correlation Analysis: Correlation Coefficient, Co-variance independent random

variables, linear regression of two variables

Project-6

Uses of Regression and Correlation Analysis in Business

Text Books:

1. Name of Author, Title, Publication, Edition

Advanced Engineering Mathematics by E. Kreyszig Publisher: John Willey & Sons Inc-8th Edition

1. **Reference Books:**

1.Statistical Methods by S.P. Gupta (31st Edition); Publisher: Sultan Chand & Sons.

2. Mathematical Statistics by S.C. Gupta & V.K. Kapur (10th Edition); Publisher: Sultan Chand & Sons.

Environmental Science [CUTM1010 (0-0-2)]

Course Objectives

- • To understand the concept of multi-disciplinary nature of Environmental Science where different aspects are dealt with a holistic approach.
  • Students will develop a sense of community responsibility by becoming aware of environmental issues in the larger social context.
  • One must be environmentally educated.

Course Outcomes

- • Understand the natural environment and its relationships with human activities.
  • Characterize and analyse human impacts on the environment.
  • Integrate facts, concepts and methods from multiple disciplines and apply to environmental problems.
  • Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Course Syllabus

MODULE - I

Environment and its multidisciplinary nature; Need for public awareness; Renewable and non -renewable resources–forest, water, mineral, land, food and energy resources; Structure and function of ecosystems of forest, grass land, desert and aquatic types.

MODULE -II

Biodiversity and its conservation: Biodiversity at global, national and local levels; Threats to biodiversity -Habitat loss; wild life poaching and man-wildlife conflicts; Endangered and endemic species; conservation measures. Causes, effects and control measures of pollution, air, water and noise pollution; nuclear hazards; solid-waste management –Causes, effects and control measures; Management of disasters due to natural causes of floods, earthquakes, cyclones and landslides.

MODULE-III

Social issues and the environment; Sustainable environment, Water conservation measures; Rain water harvesting; Resettlement and rehabilitation of people; Climate change and global warming; Acid rain; Ozone layer depletion; water land reclamation; Consumerism and waste products; Features of Environment Protection Act, Air pollution

and Control of Pollution Acts; Water Pollution and its Control Act. Effects of Pollution explosion on environment and public health; Need for value education to Protect environment and resources.

Text Book:

1. Anubhav Kaushik & C.P. Kaushik: Environmental Studies -New age International Publishers.

Reference Books:

1. Benny Joseph: Environmental Studies -Tata Mac Graw Hill

2. E. Bharucha: Text book of Environmental Studies for under graduate courses– Universities Press. (Book prepared by UGC Committee).

Mechanics for Engineers [**CUTM1006 (2-1-0)]**

Course Objectives

- To provide the students with a clear and thorough understanding on fundamentals of mechanics as applied to solve real-world problems

Course Outcomes

Upon successful completion of this course student should be able to:

- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
- Analyze the frictional forces involved in planes, ladder friction and belt friction.
- Determine the centroid and moment of inertia of composite shapes.
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
- Apply basic knowledge of mathematics and physics to solve real-world problems

Course Syllabus

Module I:

Force and Moment:

Law of Transmissibility of a Force, Composition and Resolution of Forces, Resultant and Equilibrant, Resultant of Two and Several Forces, Moment of a Force and a Couple, Varignon's Principle of Moment

Practice-1: Verification of laws of parallelogram law of forces

Module II:

Equilibrium:

System Isolation and Free Body Diagram, Particle Equilibrium, Lami's theorem, General Conditions of Equilibrium, Types of Supports and Support Reactions, Rigid Body

Equilibrium.

Practice-2: To verify the condition of equilibrium by finding reactions at the support of a beam

Module III:

Friction:

Basic Terms used in Dry Friction, Laws of Coulomb Friction, Equilibrium of Bodies on a Inclined Plane, Ladder Friction, Belt Friction

Practice-3: Determination of Angle of Repose

Module IV:

Centroid:

Axis of Symmetry, Centroid of Lines, Areas and Volumes, Centroid of Composite Section.

Module V:

Moment of Inertia:

Rectangular and Polar Moment of Inertia, Radius of Gyration, Parallel Axis Theorem and Perpendicular Axis Theorem, Moment of Inertia of Composite Section

Practice-4: Determination of Moment of Inertia of a fly wheel.

Module VI:

Kinematics of Linear Motion:

Kinematics of a Particle, Uniform and Variable Acceleration, Motion under Gravity.

Module VII:

Kinetics of Linear Motion:

Principles of Dynamics such as Newton's Second Law, Work-Energy Principle, Impulse-Momentum Principle, Law of Conservation Law of Momentum and Energy

Practice-5: Verification of Newton's second law of motion

Practice-6: Verification of conservation of momentum in collision

Text Books:

Engineering Mechanics; Statics and Dynamics by A. K. Tayal, Umesh Publications

Reference Books:

Engineering Mechanics by S. Timoshenko, D.H. Young and J.V. Rao, Tata McGraw Hill

Engineering Mechanics by D.S. Kumar, S.K. Kataria and Sons

Optics and Optical fibres [**CUTM1007 (2-1-0)]**

Course Objectives

- To train the students for Optics and the applications of laser, and optical fiber in the field of engineering and technology.
- To learn and practice the techniques used by an optical phenomenon so that these can be applied to actual field studies.

Course Outcomes

Upon successful completion of this course, students will be able to

- Understand optical phenomena.
- understand the basic knowledge of, laser, and optical fiber and instrumentation involved.
- Understand optical fiber principle, operations, and its applications.

Course Syllabus

Module I: Reflection and Refraction (Derivation is not required)

Reflection at a plane surface, reflection at spherical mirrors, Paraxial rays and approximation. Sign convention, Location of the image formation, Spherical mirror equation, Refraction, Total internal reflection, Dispersion by a prism, Refraction through a prism.

Practice: 1

To determine the refractive index of a glass slab using a traveling microscope.

Module II: Lenses (Derivation is not required

Definition, Types of Lenses, Terminology associated with the Lens, Sign Convention, Location of the image formation by graphical method for Lenses, Lens formula.

Practice: 2

To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

Module III: Interference (Derivation is not required)

Superposition principle, the definition of Interference, Coherence, Young's double-slit experiment, Newton's rings theory- Determination of wavelength of light.

Practice: 3

Newtons Ring,s-Refractive index of the liquid

Module IV: Diffraction and Polarization (Derivation is not required)

Types of diffraction, Fraunhofer diffraction at a single sit, Diffraction at N-parallel slits (plane diffraction grating). Polarisation**,** Types of polarized light and their representation,

Brewster LawTo verify Brewster's law and to find Brewster's angle. Malus Law, polarization by double refraction, polarimeter, Applications of polarized light.

Practice: 4

To find the grating element of a plane transmission diffraction grating.

Module V: Optical Properties and Laser

Scattering, refraction, reflection, absorption & transmission, Introduction to optoelectronics, Concept of Light Emitting Diode, Stimulated and spontaneous emission, Basic principle of Lasers, Population inversion, Laser Pumping, Different levels of the laser system, Ruby Laser, Applications of Lasers (Medicine, Metrology, Defenses, Nuclear energy, in communication, in the consumer electronics industry)

Practice: 5

Wave length of LASER source by diffraction grating method

Module VI: Optical Fibers

Introduction to fiber optics, the structure of optical fibers, classification of optical fibers on the variation of refractive index, Classification of optical fibers on the variation of the mode of transmission/core diameter, Numerical Aperture, Acceptance angle. Principle of optical fibers communication, optical communication (block diagram only),

Practice: 6

To find the numerical aperture of a given optic fiber and hence to find its acceptance angle.

Module VII: Optical Fibers

Attenuation in optical fibers (Qualitative only-Scattering losses, Absorption losses, bending loses). Fiber Materials-Glass fibers, Plastic fibers, Light sources for fiber optics,V-number of an optical fiber, optical fiber cables design, optical fiber connection, fiber splices, fiber connectors.Application of optical fibers- Cable TV, Networking, Power companies, Imaging,Sensors, Medical (Dental surgery, Endoscopy, Surgery)

Practice: 7

Measurement of bending loss.

Text Books:

1. A Text-Book of Optics by M.N. Avadhanulu, Brij Lal, N. Subrahmanyam, S Chand; 23rd Rev. Edn. [Module I&II]
2. Engineering Physics, by D.Thirupathi Naidu, M.Veeranjaneyulu, V.G.S Book links,2017.[Module-III,IV]

3. Principles of Engineering Physics-2 by Md.Khan, S.Panigrahi, Cambridge University Press 2016. [Module-V, VI&VII]

Reference Books:

1. Optics by Ajoy Ghatak, McGraw Hill Education; 6 editions, 2017.
2. Physics-I for engineering degree students byB.B. Swain and K.Jena.
3. Concepts in Engineering Physics by I Md. N. Kha, 2016.

Applied Analytical Chemistry [CUTM1008 (2-1-0)]

Course Objectives

- Explain fundamental principles for environmental analytical methods (titration, electrochemistry, instrumentation and basic parameters of water, soil, fuel, etc
- Point out suitable analytical techniques for analyzing a specific compounds in an environmental matrix

Course Outcomes

- Apply quality control on chemical analysis and laboratory work and explain its importance
- Plan and carry out laboratory experiments, including data analysis and conclusions
- Point out suitable techniques for sampling and handling of environmental samplesCourse Syllabus:

Course Syllabus

Module-I (4Hrs)

Water softening processes: Lime-Soda, Zeolite and Ion exchange methods. Removal of DO and dissolved CO2 from water by De-aeration method,Desalination of Brackish water by Reverse osmosis and electro dialysis process,Numericals on calculation of Temporary and Permanent hardness of water,Lime-Soda calculation

Practice

1.Determination of hardness of water by EDTA method. (V. lab)

2.Determination of alkalinity of water. (V. lab)

3.Determination of Dissolved Oxygen in water. (V. lab)

4.Determination of Biological Oxygen Demand. (V. lab)

5.Determination of Chemical Oxygen Demand. (V. lab)

Module-II (2Hrs)

Soil Analysis: Soil profile, Structure, and properties, Determination of soil properties

Practice

6.Determination of specific gravity of the soil by using piknometer. (V.lab)

7.Determination of pH and electrical conductivity of soil sample.(V. lab)

8.Determination of moisture content in soil by oven drying method. (V. lab)

Module-III (3 Hrs)

Classification, combustion and chemical principles involved in fuel, calorific value: gross and net calorific values and their determination by bomb calorimeter , Proximate and ultimate analysis of coal and their importance. LPG, Water gas, producer gas, CNG .

Practice

9.Determination of calorific value of a fuel sample by using Bomb calorimeter.

10. Analysis of flue gases by Orsat's apparatus.

Module-IV (4 Hrs)

Petroleum: its chemical composition and fractional distillation, cracking of heavy oil residues – thermal and catalytic cracking, knocking and chemical structure, octane number, synthesis and applications of bio-fuels, Photovoltaic cell.

Practice

11.Synthesis of biodiesel by trans esterification process

Module-V (3 Hrs)

Corrosion-Mechanisms, Factors affecting Corrosion; Protection from corrosion.

Practice

12.Estimation of ferrous ion in the given solution using standard potassium dichromate.

Module-VI (2Hrs)

Electrochemical Phenomenon

Electrochemical cell, Electrode potential, Determination of pH of a solution Using Clomel/ Quin Hydrone Electrode.

Module-VII (2Hrs)

Error in Chemical analysis

Types of errors, Accuracy and precision, Absolute and relative uncertainty, mean and standard deviation.

Text Books

- Engineering chemistry By Jain &Jain-16th Edn,2015, Dhanpat rai publications
- Engineering chemistry By Sashi Chawla,3rd Edn,Dhanpati roy publications,2011
- Industrial Chemistry By B.K.Sharma 21 st Edn-2018,Satya Publications4.

Reference Books

- Applied Chemistry By Aruna Kumari-2nd Edition,Paramount publications,2016
- Engineering chemistry by OG Palanna,McGrahill Education(India) private Limited,2009

- Engineering chemistry by K.Sesha Maheswaramma,Mridula.Chuch.PearsonIndia Education services pvt Ltd,2016
- Engineering chemistry by Prasanth Rath,Cengage Learning India pvtLtd,2013
- Engineering chemistry by R.V.Gadag,A.Nityananda, Shetty,I.K.International Publishishing house,2006
- Engineering chemistry –Fundamentals and applications,ByShika Agarwaal-Cambridge University PressEdition,2017

Applied Engineering Materials [CUTM1009(2-0-1)]

Course Objectives

To give an introduction to materials, ceramics, polymers, and electronic materials in the context of a molecular level understanding and their application in various field **Course Outcomes**

After completion of this course students will able to

- Understand the physical/chemical behaviors of materials.
- Select materials, based on their properties and behaviors, for a given application.
- Understand how molecular interactions to the behavior of material give rise to microscopic properties.

Course Syllabus

Module I: New Materials/Nanomaterials (5hrs)

Nanostructures and nanomaterials: classification (dimensionality, Morphology/ shape/structure of nano-entities, new effect/ phenomena). hybrid nanomaterials. effect of size, structure, mechanism, and property on material performance. applications of nanomaterials in catalysis, telecommunication and medicine.

Project 1

Synthesis of TiO_2 and ZnO nanoparticles by sol gel ,sonication and precipitation method and study their application .

Module II: Carbon Nanomaterials (5hrs)

Carbon nanomaterials, such as graphene, carbon nanotubes (CNTs), crystalline diamond, and diamond-like carbon, properties and application of fullerenes,

Project 2

Synthesis and fabrication of graphene and graphene oxide by sol-gel techniques

Module III: Polymer (5hrs)

Mechanism of polymerization and synthesis of polymers, copolymerization, viscoelasticity, elastomers-structure, conducting polymers and applications, fabrication

and moulding of polymers, synthesis, properties and uses PMMA, formaldehyde resins, melamine-formaldehyde-urea resins

Project 3

Preparation of polystyrene by anionic/cationic/emulsion polymerization method

Module IV: Composites (5hrs)

Composites: characteristics, types and applications, nanocomposites, polymer/ Metal oxide nanocomposites and its application

Project 4

Fabrication of ceramic matrix particulate composite by powder metallurgy route.

Module V: Adhesives Lubricants (4hrs)

Adhesives, adhesive mechanism and applications, lubricants-physical and chemical properties, types and mechanism of lubrication, Additives of lubricants and freezing points of lubricants

Module VI: Energy Storages Material-I (4Hrs)

Fundamental aspects related to energy storage and conversion, lithium ion batteries, lead acid batteries; nickel cadmium batteries; advanced batteries

Module VII: Energy Storages material-II (4 Hrs.)

Super capacitors, fuel cells and photovoltaic, future of battery technology

Project 5

Fabrication of fuel cell and its application

Text Books:

1.A Textbook of Engineering Chemistry, by Shashi Chawla

2.Engineering Chemistry, by P. C Jain and M. Jain

3.Advanced Polymer Chemistry, by M. Chanda

Reference Books:

1. Surfactants and Polymers in Aqueous Solution, by K. Holmberg, B. Jonsson, B.Kronberg and B. Lindman
2. Energy Scenario beyond 2100, by S. Muthukrishna Iyer

Course Syllabus for Basket-II

Optimisation Techniques CUTM1011 (0-2-0)

Course Objectives

To Create an Engineering design methodology using a mathematical formulation of a design problem to support selection of the optimal design among alternatives

Course Outcomes

- Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems
- Ability to go in research by applying optimization techniques in problems of Engineering and Technology
- Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software

Course Syllabus

Module-I: Linear Programming: Graphical Method, Simplex method, Penalty Method,

Module-II: Transportation Models, Assignment Models, Sequencing and Scheduling

Models by Johnson's Algorithm

References

- Harvey M. Wagner, *Principles of Operations Research,* Englewood Cliffs, Prentice-Hall, 1969
- S D Sharma and Himansu Sharma, Operations Research: Theory, Methods and Applications, 15 Edition, Kedarnath Ramnath & Co

Engineering Economics and Costing (CUTM1012)

Course Objectives

- Facilitate students to understand the basics of Economics and its application in the field of engineering
- Enable students to understand the concepts of the time value of money and techniques for evaluation of engineering project
- Equip students with the skills required to understand cost statements/records of the product and its effect on decision making

Course Outcomes

After the completion of the course, students will be able to:

- Understand the microeconomics concepts related to business and its impact on enterprise
- Develop an awareness and understanding time value of money and techniques for evaluation of engineering project
- Understand and apply cost concepts to analyse common business management decisions such as pricing a product and services.

Course Syllabus

Module-I

Engineering Economics – Nature and scope, General concepts on micro & macroeconomics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply.

Theory of production, Law of variable proportion, Law of returns to scale.

Module-II

Time value of money: Simple and compound interest, Cash flow diagram, Principle of economic equivalence. Evaluation of engineering projects: Present worth method, Future worth method, Net present value method, internal rate of return method, Cost-benefit analysis in public projects. Depreciation: Meaning Causes, Factors affecting depreciation, Methods of providing depreciation, Straight Line Method & Diminishing Balance Method

Module-III

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis (Simple numerical problems to be solved) Indian Banking System: Banks: Meaning, nature, characteristic of the Indian banking system, functions of commercial banks, functions of Reserve Bank of India, Overview of Indian Financial System.

Reference Books

- Sasmita Mishra, "Engineering Economics & Costing ", PHI
- Sullivan and Wicks, "Engineering Economy", Pearson
- R.Paneer Seelvan, " Engineering Economics", PHI
- Gupta, "Managerial Economics", TMH
- Lal and Srivastav, "Cost Accounting", TMH

Course Name: Project Management CUTM1013(2-0-1)

Course Objectives

- The successful development and implementation of all project's procedures.
- Learn project management methodology to initiate and manage projects efficiently and effectively
- Acquire key project management skills and strategies for Productive guidance, efficient communication and supervision of the project's team
- The achievement of the project's main goal within the given constraints

Course Outcomes

- Develop a Project Charter document for any project
- Develop Project Management Plan document

- Acquire 10 knowledge area identified by PMI and its application while delivering a projects
- Implement the Project and Prepare a project document that they have undertaken as a learning tool
- Qualify CAPM/PMP certification offered by PMI

Course Syllabus

Module: I

Project Management framework; Introduction to Project Management; Project Life Cycle and Organisation, Project vs. Operational work, Stakeholders, Organisational Influences Project Management Process for a Project, groups, Initiating, planning, executing, monitoring &controlling and closing process groups.Project management Knowledge area; Project Integration Management; Develop project charter, develop project management plan, direct and manage project execution, monitor and control project work, perform integrated change control, close project or phase.

Module: II

Project Scope Management; collect requirements, define scope, create WBS, verify scope, control scope Project Time Management; Define activities, sequence activities, estimate, develop and schedule Project Cost Management; Estimate costs, determine budget, control costs.

Module: III

Project Quality Management; Plan quality, perform quality assurance, perform quality control

Project HR Management; Develop HR plan, acquire project team, develop and manage project team Project Communications Management; Identify stakeholders, plan communication, distribute information, manage expectation of stake holders, report performance

Module: IV

Project Risk Management; Plan risks; identify risks, perform quality and quantitative risk analysis, plan risk responses, monitor and control risks Project Procurement Management; Plan procurements, conduct procurements, administer procurements, close procurements Project Stakeholders Management; Identifying stakeholders, stakeholder analysis, engagement.

References

- Project Management: A Managerial Process, Clifford F Gray & Eric W Larson, Tata McGrawHill **[Text book]**
- A Guide to the Project Management Body of Knowledge, 6th Edition, PMI
- Project Management- A system Approach to Planning, Scheduling and Controlling (Harold Kerzner). CBS Publishers and Distributers, New Delhi.
- Projects, Preparation, Appraisal and Implementation (Prasanna Chandra), 3rd Edition, Tata Mc Graw Hill, New Delhi.
- Project Management (Nagarajan, K), New Age Publishers, New Delhi.
- Project Management. A Managerial Approach (Meredith, R.J and Mantel, S.J), Wiley (India).

Course Name: Gender, Human Rights and Ethics CUTM1014(1.5-0-1.5)

Course Objectives

This course is about gender, human rights and ethics in which the student will be sensitized and exposed to related issues in the context of business and organisations in India. The specific objectives are:

• To develop an understanding of gender, human rights and ethics in an unequal society like India

• Sensitisation of how gender, human rights and ethics are significant in organisations.

• Integrating concerns related to gender, human rights and ethics in organisations.

Course Outcomes

• Understanding the complexity of issues and challenges relating to gender, human rights and ethics

• Be sensitive to gender, human rights and ethics within an organizational context,

• To integrate concerns related to gender, human rights and ethics into the policies, processes and systems in an organization.

Course Syllabus

Module 1

• Difference between sex and gender; social construction of gender and its outcomes in the form of behavior, roles, gender based division of labour, hierarchy; gender relations.

• Gender issues in organisations - significance of relations between structures, practices, context, interactions and power for construction of gender at organisational level

• Gender implications at workplace, management and leadership, Laws and Acts

• Comparing different types of organisations; how to create a gender sensitive organisation.

Module 2

• Introduction to human rights, Meaning and Definition, Types

• Human Rights Law: Protection, violation and the legal framework for their protection - International Human Rights Law, Universal Declaration of Human Rights

• Conflicts of Rights and its Significance to Organisations: Challenges of the past and challenges for the future. Persistence of social discrimination and inequality; efforts in the search for justice for past violations, continued struggle for human rights and accountability in an organisational context.

Module 3

• Introduction to and study of ethics; Indian and Western ethics

• Different ethical systems and perspectives; ethical relativism and its implications, utilitarianism, duty ethics and virtue ethics in organisations

• Critique of various ethical positions and develop their own position in an organizational context.

References

Frankena, WK, 1973, Ethics (2nd Edition), Pearson.

Singer, P. 2011, Practical Ethics (3rd ed), Cambridge University Press.

Smart, JJC and Williams, B. 1973, Utilitarianism: For and Against, Cambridge University Press.

Course Name : Climate Change, Sustainability and Organisations CUTM1015(1.5-0-1.5)

Course Objectives

- To develop an understanding about climate change in general, responses and debates
- To create awareness about the impact of climate change on organisations in performance, growth and sustainability
- To facilitate in developing reference points to factor in aspects of climate change in organizational planning and development
- To develop an understanding of sustainable development, SDGs and their relevance for sustainability of organisations
- To comprehend the application of the Integrated Reporting Framework for Sustainability in business.

Course Outcomes

- Students will be exposed to current climate change issues, challenges and debates
- They will be sensitive to its implications for organisations in different sectors

- The course will equip the students of Management to develop strategies for perspective planning of organisations
- The student will develop an understanding of perspectives on SDGs, sustainability and development in the context of organisations
- Argue the business case for sustainability informed by an understanding of the impact of current global and local economic, social and environmental pressures (including pandemics)

Course Syllabus

Module 1

- Basics of climate change; impacts on various sectors; responses and mitigation efforts by the state and non-state agencies; debates and critiques
- Sectoral implications of climate change – Agriculture and Forestry; Transportation; Buildings; Energy; Industry and Manufacturing
- Climate change – specific impacts (Migration, Disasters and Pandemics)
- Mitigation and adaptation keeping the sustainability of business organisations

Module 2

- Sustainable development, debates, SDGs, challenges and opportunities; The business case and leadership for action
- Regulatory environment and International policy; Integrated Reporting Framework for Sustainability
- Production and consumption; Design, technology, and planning for sustainability
- Communication and marketing; Collaboration and partnerships

Group Projects

Climate change impacts on

Agriculture - what is the current practice and its implications for the sector and stakeholders; enumerate policy responses; provide your own recommendations based on your understanding of issues, challenges, debates, critiques

Marine fishing – what is the current practice and its implications for the sector and stakeholders; enumerate policy responses; provide your own recommendations based on your understanding of issues, challenges, debates, critiques

Forest dwellers -what is the current practice and its implications for the sector and stakeholders; enumerate policy responses; provide your own recommendations based on your understanding of issues, challenges, debates, critiques

Business organisations – MSMEs, manufacturing, service industries; application of the integrated framework for sustainability reporting

Develop an Action Plan through a Case Study for integrating sustainability across an organisation’s value chain

Develop and apply the Integrated Reporting Framework for Sustainability through a case.

Course Name: Job Readiness

Code(Credit): CUTM1016 (0-6-0)

Course Objectives

Develop additional skills (verbal, logical, quantitative and reasoning) required to enhance employability as well as the entrepreneurial ability of the students

Course Outcomes

Achieve the following scores as a minimum:

1. IELTS 6.5
2. Verbal: 60% (average of 10 exams)
3. Quantitative: 60% (average of 10 exams)
4. Logical Reasoning: 60% (average of 10 exams)

Course Syllabus

Course Division

Course I: IELTS - Reading, Listening, Speaking and Writing

Course II: IELTS Verbal

Course III: Quantitative Aptitude

Course IV: Logical Reasoning

Course I: IELTS - Reading, Listening, Speaking and Writing

Module I: IELTS Reading

- Skimming and Scanning
- Sentence Completion
- Choose the Correct options (A, B, C, D)
- Locating the Specific Information
- Assessment on Reading Skill

Module II: IELTS Listening

- Notes/ Form/Table completion
- Label the Map/Passage, Multiple Choice Questions
- Complete the Sentences, listening to Find Information
- Assessment on Listening Skills

Module III: IELTS Speaking

- Speaking about yourself, your family, your work and your interests
- Introduction & Interview

- Topic Discussion (e.g, Environment, Covid 19, Job)
- Assessment on Speaking Skills

Module IV: IELTS Writing

- Summarising the chart, table or graph
- Comparing and contrasting graphs and tables
- Describing maps & diagrams
- Agreeing & disagreeing
- Expressing a personal view & opinion
- Assessment on Writing Skill
- CV Writing (2nd year)
- Letter Writing
- Email Writing (2nd year)
- Getting Started –writing an introduction

Course II: IELTS Verbal

Module I: Grammar (4 Hrs)

- Articles
- Prepositions
- Subject-Verb
- Spotting Errors
- Sentence Correction

Module II: Vocabulary (5 Hrs)

- Synonyms
- Antonyms
- Contextual Vocabulary

Module III: Reading Comprehension (3 Hrs)

- Paragraph/ Sentence Completion
- Jumbled Sentences/ Jumbled Paragraph

- Reading Comprehension

Module IV: Verbal Analogies (3 Hrs)

Course III: Quantitative Aptitude

Module I: Number System & Operation (14 Hrs)

- Speed Math-1: Multiplication tricks, Square, cube, square root, Cube root tricks
- Speed Math-2: Speed Calculations
- Number System-01: Operation on Numbers, Classification of Numbers, Tests of Divisibility, Unit Digit Calculation
- Number System-02: Arithmetic Progression, Geometric Progression, Factors & Factorials, Trailing Zeroes, Remainder Theorem
- HCF & LCM: Concepts, short tricks, question discussion
- Average: Concepts, short tricks, question discussion
- Assessments

Module II: Basic Arithmetic (16 Hrs)

- Percentage-01: Basics of Percentage, Effective percentage, shortcuts
- Percentage-02: Advanced questions and discussions
- Profit & Loss-01: Basics and advanced questions of Profit & Loss and shortcuts
- Profit & Loss-02: MRP, Discount, Successive discount
- Ratio & Proportion: Types of ratios, Basics & Advanced Question
- Age: Concepts & Shortcuts
- Partnership: Concepts & Shortcuts
- Mixture & Alligation: Rule of Alligation, Basics & Advanced question, Short tricks
- Assessments

Module III: Time & Analysis (17 Hrs)

- Time, Speed, Distance: Concepts, Problems based on relations, Average speed, Stoppage time
- Trains: Relative Speed & All types of train problems
- Boats & Streams: Basics, Upstream, Downstream & Shortcuts
- Race: All concepts & Shortcuts

- Time & Work: Efficiency, wages, alternative day, chain rule
- Pipes & Cistern: Positive & Negative work
- Simple Interest: Concepts & Shortcuts on Simple Interest & Installments
- Compound Interest: Concepts & Shortcuts on Simple Interest & Installments
- Logarithm: All Formulae, concepts & Shortcuts
- Assessments

Module IV: Advanced Arithmetic (16 Hrs)

- Equation: Linear & Quadratic
- Permutation: All concepts & Shortcuts on factorial, fundamental principles of counting
- Combination: All concepts & Shortcuts on Selection (Groups/teams)
- Probability: Terms related to Probability, Event, Theorems related Probability, Conditional Probability. Shortcuts on coins, dices, balls, cards, etc
- Data Interpretation: (Bar/Pi-Chart /Line) graph
- Mensuration: Area & Volume
- Height & Distance: Lines of Sight, Horizontal line, Angle of Elevation, Angle of Depression
- Assessments

Course IV: Logical Reasoning

Module I: Verbal Reasoning-I (14 Hrs)

- Series-1: Number series (Missing & Wrong)
- Series-2: Letter, Alpha numeric, Miscellaneous series
- Coding & Decoding: Letter Coding, Number coding, Message coding, Substitution coding, Conditional coding
- Word Problem: Analogy, Odd man out, word formation, letter pair
- Logical Thinking: Brain Riddles
- Assessments

Module II: Verbal Reasoning-II (14 Hrs)

- Order & Ranking: Ranking & Sequence
- Direction Sense Test: Shortest Distance, Angular movement concept and Dusk & Dawn

- Clock: Concepts of Angle, Reflex angle, Right angle Opposite, Coincide and Incorrect clock
- Calendar: All concepts & Shortcuts
- Blood Relation: Jumbled-up descriptions, coded relations, Relation Puzzles
- Assessments

Module III: Non Verbal Reasoning (14 Hrs)

- Cubes & Dices
- Cubes & Cuboids
- Embedded Figure& Figure series
- Figure Puzzle & Figure grouping
- Figure Counting
- Mirror & Water Image
- Paper Cutting & Paper folding
- Assessments

Module IV: Advanced Reasoning (16 Hrs)

- Sitting Arrangement: Circular, Square, Rectangular, Linear, Triangular
- Puzzle: Box, Floor, Month, Day
- Advanced Puzzle: 3 variable
- Logical Venn Diagram
- Syllogism
- Statement & Conclusion
- Data Sufficiency
- Assessments

Course Syllabus for Basket-III

Course Name: Industrial IoT and Automation CUTM1017(3-2-1)

Course Objectives:

By 2025, there will be 50 billion devices connected to the Internet. How will the students capitalize on this tremendous opportunity?
-Students will learn the new evolution in hardware, software, and data.
-While the promise of the Industrial Internet of Things (IIoT) brings many new business prospects, it also presents significant challenges ranging from technology architectural choices to security concerns.
-Students acquire upcoming Industrial IoT: Roadmap to the Connected World Course offers important insights on overcoming the challenges and thrive in this exciting space.

Course Outcomes:

-Discover key IIoT concepts including identification, sensors, localization, wireless protocols, data storage and security
-Explore IoT technologies, architectures, standards, and regulation
-Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices
-Examine technological developments that will likely shape the industrial landscape in the future
-Understand how to develop and implement own IoT technologies, solutions, and applications
-At the end of the program, students will be able to understand how to develop and implement their own IoT technologies, solutions, and applications.

Course Syllabus

MODULE 1: Introduction & Architecture

Theory

What is IIoT and connected world? the difference between IoT and IIoT, the web of things, architecture of IIoT.

Practice

1. Simulation of RFID using Matlab/Dymola

MODULE 2: *Communication Technologies of IIoT*

Theory

Industry standards communication technology (LoRAWAN, ZigBee, OPC UA, MQTT), wireless network communication, security issues in IIoT.

Practice

2. Demonstration of MQTT communication using Matlab/Dymola.
3. Site visit to Apparel factory in the Bhubaneswar campus.
4. Wireless communication demonstration using Matlab/Dymola.

MODULE 3*: Visualization and Data Types of IIoT*

Theory

HMI in an IIoT world, enterprise data for IIoT, emerging descriptive data standards for IIoT.

Practice

5. Assembling the HMI for IIoT environment using Matlab/Dymola.
6. Measurement of temperature & pressure values of the process using sensors.

MODULE 4: *Automation*

Theory

Automation definition, automation pyramid, field level sensors, HMI in an automation process.

Practice

7. Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')
8. Wearable sensing for IoT (future user interfaces for IoT - new ways to control and interact with your environment)

MODULE 5*: Control & Supervisory Level of Automation*
Theory
Programmable logic controller (PLC), Supervisory Control & Data Acquisition (SCADA).
Practice
9. Simulation of PLC to understand the control concept.
10. SCADA HMI demonstration using Matlab.
11. SCADA simulation using Matlab/Dymola.
MODULE 6: *Planning Level & Management Level*
Theory
Manufacturing Execution System (MES), Enterprise Resource Planning (ERP),
Practice
12. Designing MES system by using Adobe.
Text Books
1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2. Industrial Internet of Things: Cybermanufacturing System**,** Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)

Course Name: Data Analysis and Visualisation Using Python CUTM 1018(0-1-3)

Course Objectives

- How to tell a story from data?
- How to marshal the data for storyline?
- The ability to develop visualization to tell the story
- The focus is on analysis of data using visualization as a tool

Course Outcomes

- To create impactful visualization with good story line.

Course Syllabus

Module-I

STORY BOARD DEVELOPMENT

The objective and flow of the story to be understood through cases

Module-II

DATA READING USING PYTHON FUNCTIONS

Python libraries: Pandas, NumPy, Plotly, Matplotlib, Seaborn, Dash

Data collection from online data sources, Web scrap, data formats such as HTML, CSV,

MS Excel, data compilation, arranging and reading data, data munging

Module-III

DATA VISUALSATION USING PYTHON LIBRARIES

Different graphs such as Scatterplot, Line chart, Histogram, Bar chart, Bubble chart,

Heatmaps etc.

Dashboard Basics – Layout, Reporting, Infographics, Interactive components, live

updating

Projects List

1. COVID 19

2. World Development Indicators

3. ERP dashboarding

4. Details of Social/ Empowerment schemes of Govt. etc.

Course Name: Machine Learning using Python CUTM1019(1-2-1)

Course Objectives

- Understand the meaning, purpose, scope, stages, applications, and effects of ML.
- Explore important packages of python, such as numpy, scipy, OpenCV and scikit-learn.

Course Outcomes

Students will able to Create and incorporate ML solutions in their respective fields of study.

Course Syllabus

Module 1 – Application and Environmental-setup (12 hrs)

- ✓ Applications of Machine Learning *in* different fields (Medical science, Agriculture, Automobile, mining and many more).
- ✓ Supervised vs Unsupervised Learning based on problem Definition.
- ✓ Understanding the problem and its possible solutions using IRIS datasets.
- ✓ Python libraries suitable for Machine *Learning (*numpy, scipy, scikit-learn, opencv)
- ✓ Environmental setup and Installation of important libraries.

Module 2 - Regression (8 hrs)

- ✓ Linear Regression
- ✓ Non-linear Regression
- ✓ Model Evaluation in Regression
- ✓ Evaluation Metrics in Regression Models
- ✓ Multiple Linear Regression
- ✓ Feature Reduction using PCA
- ✓ Implementation of regression model on IRIS datasets.

Module 3 - Classification (24 hrs)

- ✓ Defining Classification Problem with IRIS datasets.
- ✓ Mathematical formulation of K-Nearest Neighbour Algorithm for binary classification.
- ✓ Implementation of K-Nearest Neighbour Algorithm using sci-kit learn.
- ✓ Classification using Decision tree.
- ✓ Construction of decision trees based on entropy.

- ✓ Implementation of Decision Trees for Iris datasets .
- ✓ Classification using Support Vector Machines.
- ✓ SVM for Binary classification
- ✓ Regulating different functional parameters of SVM using sci-kit learn.
- ✓ SVM for multi class classification.
- ✓ Implementation of SVM using Iris datasets .
- ✓ Implementation of Model Evaluation Metrics using sci-kit learn and IRIS datasets.

Module 4 - Unsupervised Learning (12 hrs)

- ✓ Defining clustering and its application in ML .
- ✓ Mathematical formulation of K-Means Clustering.
- ✓ Defining K value and its importance in K-Means Clustering.
- ✓ Finding appropriate K value using elbow technique for a particular problem.
- ✓ Implementation of K-Means clustering for IRIS datasets
- ✓ Projects
- ✓ To be defined based on respective study area of student.

Course Name: System Integration with DYMOLA CUTM1022(0-0-2)

Course Objectives

- To provide powerful multi-disciplinary systems engineering through compatible model libraries for a large number of engineering domains.
- To design high-fidelity modeling of complex integrated systems.
- To design intuitive modeling i.e. advanced, formally defined object-oriented modeling language.
- To enable users to easily build their own components or adapt existing ones to match their unique needs.
- To provide hardware-in-the-loop simulations (HILS) i.e. real-time simulation with AurdinoUno, Python, Matlab, 3D real-time animation, CAD files import capability.
- To increase the ability to integrate with complex 3D geometry for integrated simulation.
- To increase powerful model management, calibration & optimization capabilities.

Course Outcomes

- The use of open standards such as DYMOLA (Modelica and FMI) is a key enabler to better understand the behavior of systems and to work and communicate accurately with partners and suppliers.
- DYMOLA is not only capable to support an ad-hoc modeling level, such as functional behavior or detailed design, but is also able to convert these predictive models into real-time models.
- The user can able to create new elements in an easy and intuitive way, to answer to its own modeling requirements.
- Future Centurions are ready for operating in many industries including automotive, aerospace, architecture, Motorsport, energy, and high tech.

Course Syllabus

Module 1 - Introduction Dymola and Modelica library

-Package Browser, Component Browser, Parameter and Variable Editor Simulation Window, Modeling, and Simulation.

-The Modeling window is used to compose models and model components.

-The Simulation experiment on the model, plot results and animate the behavior.

-Creating user-defined models and scripting using Modelica language.

-Role Play – Explore the pre-defined libraries and Models, Creating a Package

Practice Project

- Preparation of animated projects

Module 2 – Physical Modeling using DYMOLA

-Import of user-defined libraries and packages, Interfacing with physical models using Arduino Uno.

-The Simulation experiment on the model using multi-domain libraries such as mechanical, electrical, control, thermal, pneumatic, hydraulic, powertrain, thermodynamics, vehicle dynamics, air-conditioning domains

-Dymola interface that is stored in the Python package

-Role Play – Explore the pre-defined libraries and Models, Creating a Package

Practice Project

- Preparation of projects using user-defined packages,
Systems Physics with Modelica/Dymola

Module 3 – Animation and 3D view Using DYMOLA

-MultiBody Frame Connector, Building a Mechanical Model, Concept of Furuta

-Role Play - Practical session by students for students

Practice Project

- Modeling of animated projects using the MultiBody library.

Course Syllabus for Basket-IV

Basket IV A

Course Name: Manufacturing Process-Process Planning and Heat Treatment

Course Code: CUTM1079

Course Credits : 2-1-0

Course Objective

1. To Understand the Importance of Materials, Manufacturing Processes, Process Planning & Design in Product Manufacturing

Course Outcomes

Students will able to

1. Select Engineering Material for a Required Purpose
2. Identify Various Manufacturing Processes
3. Implement Modern Approaches to Process Planning, Product Design & Development

Course Syllabus

Module I: Classification of Materials (5 hrs)

Common Engineering Materials; **Crystal Geometry** (Crystal Types, Crystal Structures, Crystal Defects, Recrystallization, Crystal Growth, Methods of Determining Crystal Structure, Scanning Electron Microscope); **Mechanical Properties, Mechanical Tests and Deformation of Materials (**Mechanism of Strengthening in Metals. Grain Size and its relation to Mechanical Properties, Review and Brief Discussion on Stress-Strain Diagram of Steel and the Parameters for Ductility, Percentage of Elongation, Toughness, Strain Hardening, and Tensile Strength, etc., Fracture Toughness and Crack Growth Measurement, Failure Analysis), Fatigue and Creep Testing, Testing for Residual Stresses.

Module II: Tool Materials (4 hrs)

Engineering Alloys (Selection and Specification of Carbon and Alloy Steels for General Engineering Purpose, Specification of Materials as per Various Standards- IS, BS, AISI, APS, etc.); **Steels** (Case Hardening Steels, Cold Work Tool Steels, Hot Work Tool Steels, High-Speed Tool Steels; **Modern Cutting Tool Materials** (Carbide, Coated carbides, Ceramics, CBN, Diamond, Sialons, Impregnated tools); **Introduction to Plastics** (Properties of Plastics, Thermo Plastics-Thermo Setting Plastics, Methods of Processing of Plastics); **Cast Iron** (Grey Iron Casting IS: 210 SG Cast Iron IS: 865, Malleable Iron Castings IS: 2108 and IS: 2640); **Non-Ferrous Alloys** (Zn & Al

Alloys); **Powder Metallurgy** (Methods for Production of Powders, Powder Metallurgy Steps).

Module III: Heat Treatment (4 hrs)

Heat Treatment of Steel (Hardenability Concepts and its Role in Steel Specification, Hardening and Annealing of Tool Steels, Case Hardening and Local Hardening, Isothermal Transformation Diagrams, Austempering, Martempering and Isothermal Annealing for Tool Steels, Major Defects in Metals or Alloys due to Faulty Heat Treatment, ION Nitrating, Vacuum Carburizing, Chemical Vapour Depositing)**; Heat Treatment of Non-ferrous Materials** (Classification of Heat Treatment Processes for Aluminium Alloys, Heat Treatment of Wrought & Cast Aluminium Alloys).

Module IV: Manufacturing Processes (7 hrs)

Forming Processes (Cold & Hot Working, Rolling, Forging, Drawing, Bending & Extrusion)**; Joining Processes** (Arc Welding, Gas Welding, Resistance Welding, Thermit Welding, TIG & MIG Welding, LBW, EBW, Adhesive Bonding, Soldering & Brazing,)**; Casting Process** (Sand Casting, Die Casting, Investment Casting, Centrifugal Casting, Vacuum Casting, Plaster Mould Casting, Lost Foam Method, Continuous Casting); **Machining Processes** (Traditional-Turning, Milling, Drilling, Shaping, Grinding & Finishing, Non-Traditional- EDM. AJM, LBM etc.)

Practice

1. Pattern & Mold Making in Sand Casting.
2. Butt Joint by using Oxy Acetylene Gas Welding.
3. Joining of Metal Sheets using Spot Welding.
4. Soldering & Brazing Practice.
5. TIG Welding of Stainless Steel
6. MIG Welding Technique and Applications
7. EDM working Principle and Process Parameters

Module V: Process Planning (5 hr)

Process Planning (Concept, Manufacturing Planning, Process Design, Process Planning Activities, Process Sheet, Process Selection Parameters, Steps in Process Planning, Computer-Aided Process Planning)

Practice

1. Process Planning & Simulation in DELMIA

Module VI: Computer-Aided Production Management (7 hrs)

Role of Computer in Product Design and Management (Computer in Manufacturing & Design Process, Creation of Manufacturing Data Base, Computer Integrated Manufacturing, Communication Network, Production Flow Analysis, Group Technology); **Process & Product Design** (Degree of Accuracy, Finish and Tolerance, Capability Studies, Basic Product Design Rules for Casting, Forging, Machining, Sheet Metal, and Welding. Physical Properties of Engineering Materials and their Importance on Products, Selection of Plastics, Rubber, Composites, and Ceramics for Product Design)

1. Casting Design & Analysis using CATIA
2. Forging Design & Analysis using CATIA

Module VII: Industrial Ergonomics (3

Hrs)

Man/Machine Considerations, Ease of Maintenance. Ergonomic Considerations in Product Design, Anthropometry, Design of Controls & Displays, Man/Machine Information Exchange, Process Sheet Detail and Their Importance, Advanced Techniques for Higher Productivity, Just-in-Time and Kanban System, **Modern Approaches to Product Design** (Concurrent Design, Quality Function Development, Rapid Prototyping)

Course Name : Computer Aided Drafting

Code(Credit) : CUTM1075 (0-2-1)

Course Objectives

- Students will learn
  • how to create simple parts, assemblies and drawings.
  • how to use different feature-based tools to build, review and modify a model.
  • how to create and analyze assemblies and how to produce a drawing with different

views.
• learn how to dimension the drawing and annotate the views.

Course Outcomes

- • Students will be able to use CATIA for creation of 3D models, Assembly Designs and Drawings

Course Syllabus

Module I: Sketcher - Creating Profiles 2 (hrs)

PLM Objects, Sketch Support, Simple elements, constraining sketches, simple and complex profiles, transforming sketches, saving documents

Practice-1 : Hands on Session on Sketcher Workbench

Module II: Part Design -Creating Basic Features 5 (hrs)

Extruded Features, revolved features, holes, threads, taps, drafts, fillets, chamfers, shelling and stiffeners, relational dimensions,

Practice-2 : Hands on Session on Sketch Based Features & Dress Up Features

Practice-3: Hands on Session on Transformation Features

Module III: Reviewing & Modifying 2 (hrs)

Measuring the model, re using the data, editing features

Practice-4: Hands on Session on Measuring Tools & Editing Features

Module IV: Finalizing Design 5 (hrs)

Adding parameters, reusing features, rendering, weight calculation,

Practice-5: Hands on Session on Parametric Design

Practice-6: Hands on Session on Rendering, Material Addition

Module V: Creating & Managing Products 6 (hrs)

Positioning Components, constraining Components, Analyzing weight distribution, replacing and revising parts

Practice-7: Hands on Session on Assembly Design

Practice-8 : Hands on Session on Digital Mock Up

Module VI: Creating Drawings 4 (hrs)

Creating Drawing, Modifying, dimensioning, Annotations, Finalizing & Printing

Practice-9 : Hands on Session on Drawing Conventions

Practice-10: Hands on Session on Creating Drawings

Module VII: Master Exercise (5 hrs)

Heat Sink , PC Card Slide

Practice-11 : Modeling of Heat Sink

Practice-12: Modeling and Assembly of PC card Slide

Text Books/ Reference Books/ Reference Material

1. Mechanical Design Fundamentals : Dassault Systemes Companion Learning Space Material

Thermodynamics

CUTM 1088 (2-1-0)

Course Objectives

• To know the laws of thermodynamics and conditions for energy transformation

• To get familiarity with different thermodynamic properties of pure substances

• To acquire knowledge of the temperature scales

• To get familiarity with various laws of thermodynamics

• To get familiarity with the various properties of steam

Course Outcomes

On completion of the course the student will be able to:

• Apply the knowledge of thermodynamics to temperature scales

• Utilize the concepts of work and energy to evaluate control volumes as well as closed systems

• Students will be able to do energy analysis and determine efficiency of various thermal devices

• Students are able to identify steam proprieties from steam tables and Mollier charts.

Course Syllabus

Module I: Basic Concepts of Thermodynamics4(hrs)

System, Surroundings, Universe, State, Thermodynamic Properties, Process, Types of Process, Reversible and Irreversible process, Quasi-static Process, Cycle, Point and path functions, Thermodynamic Equilibrium, Ideal gas, Ideal gas equation

Module II: Zeroth Law of Thermodynamics4(hrs)

Zeroth Law of Thermodynamics, Temperature, Measurement of Temperature, Temperature Measuring Instruments, Relationship between Temperature Scales

Practice:

• Temperature measurement by using thermocouple, Thermistors and Resistance temperature detector (RTD)

Module III: Work Transfer and Heat Transfer 5(hrs) Work Transfer, Sign Convention of Work, PdV Work for Various Quasistatic Processes, Heat Transfer, Different Modes of Heat Transfer

Practice:

- Simulation of Heat Transfer in Conduction, Convection and Radiation using Finite Element Method in Simulia (Plane Wall, Fin, Metal Rod)
- Thermal Stress Analysis of IC Engine Piston using Simulia
- Thermal Analysis of Intake Manifold of Engine using Simulia
- Thermal Analysis of a Battery using Simulia

Module IV: First Law of Thermodynamics6(hrs)

First Law of Thermodynamics Applied to Closed System, Energy, PMM1, Enthalpy,Specific Heat at Constant Volume and Constant Pressure, First Law of Thermodynamics Applied to Open System, Control Volume, Mass Balance and Energy Balance, Nozzle, Diffuser, Turbine, Compressor, Throttling Device, Heat Exchanger

Practice:

- Thermal Analysis of Nozzle, Diffuser, Turbine, Compressor, Boilor, Heat exchanger using Simulia

Module V: Second Law of Thermodynamics 5(hrs)

Kelvin Planks statement,Clausius Statement, PMM2, Working of Heat Engine, Refrigerator and Heat Pump,Carnot Cycle & Carnot Theorem

Practice:

• Working of Refrigerator and Heat Engine

Module VI: Entropy4(hrs)

Introduction to Entropy, Principle of Increase of Entropy, Clausius Inequality, Change in Entropy in Different Processes

- **Practice**:Entropy Change of Metal Bar with Temperature Gradient using Simulia

Module VII: Properties of Pure Substances 5(hrs)

Introduction to Pure Substance, Phase Change Processes of Pure Substances, T-V, P-V, P-T and H-S Diagram for Steam, Dryness Fraction of Steam, Different Types of Steam.

Introduction to Steam Tables: Specific Volume, Pressure, Temperature, Enthalpy and Entropy

Practice:

- Conversion of water to steam
- Determination of properties of steam from Mollier Chart

Text Books:

1. P.K. Nag, "Engineering Thermodynamics", Tata Mcgraw-Hill Publishing Company Limited

2. Y.A Cengel, M. A Boles, "Thermodynamics an Engineering Approach", Tata Mcgraw-Hill Publishing Company Limited

Reference Books:

1. R K Rajput, "A Text Book of Engineering Thermodynamics ", Laxmi Publications

2. Sontag,Borgnakke,VanWylen, " Fundamentals of Thermodynamics", Willey Publisher

Course outline Prepared by DrPSVRamanaRao and Prof. ManasRanjanPadhi Date:25.5.20

Source of reference; Udemy, Coursera,VirtualAmrita Laboratories Universalizing Education

Course Name : Electronic Devices and Systems

Code(Credit) : CUTM1046(2-1-0)

Course Objectives

- The course is designed to be a broad introduction to electronic systems for students from diverse engineering disciplines. Completing the course will provide the necessary foundation to understand the role, capabilities and constraints of electronics in contemporary engineering systems.
- This course develops a basic understanding of the fundamentals and principles of analog and digital circuits and electronic devices. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system.

Course Outcomes

- Understand operation of semiconductor devices.
- Understand the current voltage characteristics of semiconductor devices.
- Design and analyze of electronic circuits.
- Evaluate frequency response to understand behavior of Electronics circuits
- Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation.

- To apply concepts for the design of Regulators and Amplifiers.
- To verify the theoretical concepts through laboratory and simulation experiments.
- To implement mini projects based on concept of electronics circuit concepts.

Course Syllabus

Module I: Semiconductor Diodes, Diode Applications (5 Hrs)

Semiconductor Physics, Semiconductor Diode and analysis, Zener Diodes, Light-Emitting Diodes, realization of logic gates using diodes, rectifier circuits.

Practice:

1.1 V-I Characteristics of PN Junction diode and ZENER diode. (Both hardware and MULTISIM)

1.2 Implementation of Full-Wave rectifier. (Both hardware and MULTISIM).

1.3 Implementation of AND/OR gates. (Both hardware and MULTISIM)

Module II: Bipolar Junction Transistors, Field-Effect Transistors (4 Hrs)

Transistor Construction and characteristics, Construction and Characteristics of JFETs, MOSFET

Practice:

2.1 Input - Output Characteristics of CB/CE/CC configuration BJT. (Both hardware and MULTISIM)

2.2 Output and transfer Characteristics of FET. (Both hardware and MULTISIM)

Module III: DC Biasing—BJTs. BJT AC Analysis, FET Biasing , FET Amplifiers , BJT and JFET Frequency Response (6 Hrs)

Load-Line Analysis, Operating Point, biasing techniques, AC analysis of BJT and FET, General Frequency Considerations, Low-Frequency Analysis of BJT, FET

Practice:

3.1 Frequency response of self biased BJT amplifier. (Both hardware and MULTISIM)

3.2 Frequency response of CS FET amplifier. (Both hardware and MULTISIM)

Module IV: Operational Amplifiers, Op-Amp Applications, Linear-Digital ICs (6 Hrs)

Practical Op-Amp Circuits and various parameter analyses, various applications, Timer and PLL ICs

Practice:

4.1 Design and implement of Adder, Subtractor using IC 741. (Both hardware and MULTISIM)

4.2 Design and implement of Integrator and Differentiator using IC 741. (Both hardware and MULTISIM)

4.3 Design and implement of Any oscillator using IC 741. (Both hardware and MULTISIM

Module V: Power Amplifiers, Feedback and Oscillator Circuits (5 Hrs)

Various classes of power amplifier and their characteristics, design of various oscillators and its applications

Practice:

5.1 Design and implement of Class-C power amplifier (Both hardware and MULTISIM)

5.2 Design and implement of RC Phase shift oscillator (Both hardware and MULTISIM)

5.3 Design and implement of UJT relaxation oscillator (Both hardware and MULTISIM)

Module VI: Power Supplies (Voltage Regulators) (4 Hrs)

Various filters, Voltage regulator, Design and different IC voltage regulators.

Practice:

6.1 Regulation characteristics of transistor voltage regulator.(Both hardware and MULTISIM).

6.2 Regulation characteristics of IC7805/7912 voltage regulators.(Both hardware and MULTISIM).

Module VII: Other Two-Terminal Devices, *pnpn* and Other Devices (4 Hrs)

Varactor diode, photodiode, solar cell, tunnel diode, LCD, thermisters, SCR construction, applications, UJT

Text Books:

1. Electronic Devices and Circuit Theory, Eleventh Edition: Robert L. Boylestad. Louis Nashelsky
2. Electronic Principles and Applications , Ninth Edition: Charles A. Schuler

Reference Books

1. Electronic Devices and Circuits : GSN Raju
2. Electronic Devices: Systems and Applications: Robert Diffenderfer.

Course Name : Basic Electrical Engineering

Code(Credit) :CUTM1057 (1-1-0) 2 Credits

Course Objectives

- In this course, student will come to know about the Basics of Electrical Engineering, Currents and Voltages across various Electrical elements.
- Their behavior in both Alternating Current and Direct Current circuits.
- Analysis of 1-phase and 3-phase AC wave forms.

Course Outcomes

- Student will be exposed to the breadth of electrical engineering, able to gain knowledge in Electrical Circuits (AC and DC).
- Acquire knowledge on various parameters of electrical engineering and their properties with hands-on-practice of basic electrical experiments.
- Acquire basic knowledge on electromagnetism.
- Application of electromagnetism in generating electricity.
- Knowledge gain on AC 1-ϕ and 3-ϕ circuits.

Course Syllabus

Module I: Basic Concepts and Basic Laws

(4hrs)

Theory

Essence of Electricity, Electric Field; Electric Current, Potential and Potential Difference, E.M.F., Electric Power, Ohm's Law, Basic Circuit Components, Ideal and Practical Sources, Source Conversion.

Practice:

1. Design and Analysis of Basic electrical circuits using Dymola. Plotting the V-I Characteristics of Incandescent lamp using Dymola.

Module II: Methods of Analysis (4hrs)

Theory

Network Analysis using Series and Parallel Equivalents, Voltage and Current Divider Circuits, Nodal Analysis, Mesh Analysis, Delta-Star & Star-Delta conversion.

Practice :

2. Verification of KCL and KVL in series and parallel circuits using Dymola.

Module III: DC Network Theorems (3hrs)

Theory

Analysis of Superposition, Thevenin's and Norton's theorem.

Practice:

3. Verification of Superposition, Thevenin's and Norton's theorem using Dymola.

Module IV: Introduction to Electromagnetism (4hrs)

Theory

Magnetic Circuits, B-H curve, Permeability, Reluctance, Solution of simple magnetic circuits, Hysteresis and Eddy current loss. Methods of preventing such losses. Solenoids and field coils. Application of solenoids in different circuits in Automobiles and in electrical circuit.

Practice (Hardware):

4. Observation of generation of magnetic flux for different input current in a coil and plotting B-H Curve.

Module V: Single-Phase Transformer (2hrs)

Practice (Hardware):

5. Study of Transformers, Linear Transformer Model, Ideal Transformer Model, No-load Loss and Load-loss Calculation.

Module VI: AC Circuit Analysis (3hrs)

Theory

Single-phase EMF Generation, Waveform and Phasor Representation, Average and Effective value of sinusoids, Peak factor & Form factor, Complex Impedance and Power using j-operator, Power factor.

Practice:

6. Calculation of current, voltage, power & power factor of series RLC circuit excited by 1-Ø A.C Supply using Dymola.

Module VII: Phasor Analysis (3hrs)

Theory

Three-Phase AC Circuits: Comparison between single-phase and three-phase systems, Three-phase EMF Generation, Line and Phase quantities in star and delta networks, Power and its measurement in three-phase balanced circuits.

Practice

7. Measurement of power and power factor in a 3-Ø AC circuit by (one, two and three) wattmeter using Dymola.

***Recommended Books**:*

1. P. K. Sathpathy, "Basic Electrical Engineering," 3rd Edition, Oxford.

2. B. L. Thereja, "Electrical Technology", Volume-I,2005 Edition(24th Revised Edition)

3. Hughes, "Electrical & Electronic Technology", Ninth Edition (Revised by J Hiley, K Brown, and I Smith), Pearson Education

Course Name : Human Anatomy and Physiology

Code(Credit) : CUTM1078 (2-1-0)

Course Objectives

• To define main structure composing human body.

• To describe the structure of the human body on cell-, organs-, organ system- and organism level.

• Describe the relationships between structure and function of the human body.

• To gain the scientific based knowledge of the structure and function of the human body.

Course Outcomes

• Skill and ability On completion of the course, the student should be able to:

• Carry out cardiopulmonary resuscitation (CPR)

• Carry out pulse- and blood pressure measurement

• Relate physiological examination methods to the function of the circulatory- and the respiratory organs.

Course Syllabus

Module I

Scope of Anatomy and physiology. Definition of various terms Terms and terminology used in Anatomy. Structure of cell, function of its components with special reference to

mitochondria and microsomes.

Elementary tissues: Elementary tissues of the body, i.e. Anatomy of epithelial tissue, muscular tissue, connective tissue and nervous tissue.

Skeletal System: Structure and function of Skelton. Classification of joints and their function. Skeleton system with classification, types of bone, features of long bone, ossification, blood supply, Joints – classification with examples, structure of typical synovial joints, Joint disorders.

Practice: Demonstration of individual bone from skeleton.

Identification of different organs and system from chart.

Module II

Cardiovascular System: Composition of blood, functions of blood elements Composition and functions of blood. Blood groups Blood groups – ABO system and Rh factor and coagulation of blood. Brief information regarding disorders of blood. Name and functions of lymph glands. lymph – origin, circulation, functions of lymph and lymph nodes. Structure and functions of various parts of the heart. Blood pressure and its recording. Brief information about cardiovascular disorders.

Respiratory system: Various parts of respiratory system and their functions, Introduction and functional anatomy of respiratory tract, physiology of respiration.

Practice: Demonstration the morphology of different blood cells

Measurement of Blood pressure, impulses, Heart beats, respiration rate etc.

Module III

Urinary System: Various parts of urinary system and their functions, structure and functions of kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema.

Digestive System: names of various parts of Anatomy of digestive system and their functions. Structure and functions of liver, physiology of digestion and absorption.

Endocrine System: Endocrine glands and Hormones. Reproductive system. Structure and function of sense organs.

Practice: Demonstration of various parts of body, tissues of body, parts of digestive system, parts of respiratory system, parts of excretory system. Identification of different organs and system from chart

Course Name: Medicinal & Aromatic Plant Crops I

Code(Credit): CUTM2330 (2-1-0)

Course Objectives

To understand and practical application of Medicinal and Aromatic plants plantation, collection and their storage.

Course Outcomes

- To understand various concepts in MAP cultivation
- To Know various considerations in development of MAP cultivation
- Students will be able to plan and prepare the scheme for MAP production
- To correlate the theoretical knowledge with professional and practical need of MAP agriculture practice.
- Able to select the appropriate MAP for cultivation as per season, climatic condition and geographical location. Enable students to become entrepreneur.

Course Syllabus:

Module 1

History, scope, opportunities and constraints in the cultivation and maintenance of medicinal and aromatic plants in India.

Module 2

Indian institutions involved in medicinal plants promotion: National Medicinal Plants Board, Role of NGO in Medicinal Plants Cultivation, Programme of State Government on Medicinal Plants, & NATIONAL MISSION ON MEDICINAL PLANTS.

Module 3

Importance, origin, distribution, area, production, climatic and soil requirements, propagation and nursery techniques, planting and after care, cultural practices, training and pruning, nutritional and water requirements. Plant protection, harvesting and processing of under mentioned important medicinal and aromatic plants.

Medicinal Plants: Amla, Belladona, Costus, Belladona, Datura, Digitalis, Isabgol, Kalmegh, Liqourice, Coleus, Glory lily, Senna, Periwinkle, Phyllanthus, Pyrethrum, Cinchona, Rauvolfia, Dioscorea, Isabgol, Aloe vera, Solanum viarum, Piper longum, Ashwgandha, Guggul, Neem Opium poppy, Roselle, Safed Musli and other species relevant to the local conditions.

Aromatic Plants: Citronella, Lemon grass, Palmarosa, Vetiver, Rosemary, Scented Geranium, Patchouli, Basil, Artemisia, Thyme, Ambrette, French Jasmine, Mints, Chamomile, Davana, Kewda Khus, Lemon scented gum, Patchouli, Oil bearing rose, Tuberose, Lavender and other species relevant to the local conditions.

Practice

Land preparation, Seed treatment, raising of seedling and nursery management, Incorporation of mulching material, Nutrient, water, weed, plant-protectant management, Application of micronutrients, Special Horticultural operation, Harvest and Post-harvest handling.

Reference :

1. Farooqi, A. A., & Sreeramu, B. S. (2004). *Cultivation of medicinal and aromatic crops*. Universities Press.
2. Gyanya, A. (2016). Hand book of medicinal and aromatic plants cultivation. *Central Institute of medicinal and aromatic plants, CIMAP, Lucknow*.
3. Atal, C. K., & Kapur, B. M. (1977). Cultivation & utilisation of medicinal and aromatic plants.
4. Panda, H. (2002). *Medicinal plants cultivation & their uses*. Asia Pacific Business Press Inc.
5. Lipman, E. (Ed.). (2009). *Report of a working group on medicinal and aromatic plants*. Bioversity International.

Course Name: Medicinal & Aromatic Plant Crops II

Code(Credit): CUTM2331 (2-1-0)

Course Objectives

To understand and practical application of Medicinal and Aromatic plants plantation, collection and their storage.

Course Outcomes

- To understand various concepts in MAP cultivation
- To Know various considerations in development of MAP cultivation
- Students will be able to plan and prepare the scheme for MAP production
- To correlate the theoretical knowledge with professional and practical need of MAP agriculture practice and post-harvest management of MAP crops.
- Able to select the appropriate MAP for cultivation as per season, climatic condition and geographical location. Enable students to become entrepreneur.

Course Syllabus:

Module 1

Scope and importance of post-harvest technology. Post-harvest handling of wild and cultivated types of MAPs. Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes. Post-harvest losses.

Module 2

Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage ventilated, refrigerated, MAS, CA storage. Pre-cooling, sorting & grading, packaging, transportation and marketing. Cool chain. Preservation principles and practices for MAPs. Semi processing, adulteration, packaging and labeling.

Module 3

Harvesting, grading, drying and storage of medicinal plants. Post-harvest handling of aromatic plants. Active content dynamics vis-a vis plant growth and post-harvest processing for evaluation of chemical constituents. Influence of post harvesting practices on active principles of MAPs.

Practice

Post-harvest lab techniques such as pre-and post-drying processes, and plant parts removal by

cutting, crushing, and milling. post-drying separation and classification.

Reference :

6. Farooqi, A. A., & Sreeramu, B. S. (2004). *Cultivation of medicinal and aromatic crops*. Universities Press.
7. Gyanya, A. (2016). Hand book of medicinal and aromatic plants cultivation. *Central Institute of medicinal and aromatic plants, CIMAP, Lucknow*.
8. Atal, C. K., & Kapur, B. M. (1977). Cultivation & utilisation of medicinal and aromatic plants.
9. Panda, H. (2002). *Medicinal plants cultivation & their uses*. Asia Pacific Business Press Inc.
10. Lipman, E. (Ed.). (2009). *Report of a working group on medicinal and aromatic plants*. Bioversity International.

Course Name : Industrial Pharmacy-II

Code(Credit) : BPHT4102(4-0-0)

Course Objectives

To impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Course Outcomes

1. Know the process of pilot plant and scale up of pharmaceutical dosage forms
2. Understand the process of technology transfer from lab scale to commercial batch
3. Know different Laws and Acts that regulate pharmaceutical industry
4. Understand the approval process and regulatory requirements for drug products

Course Syllabus

Module I:

Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology.

Module II:

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal

issues.

Module III:

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals.

Module IV:

Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.

Module V:

Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP.

Module VI:

Indian Regulatory Requirements: Central Drug Standard control Organizaion (CDSCO), State Lisencing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for new drugs.

Course Name : Heat and Mass Transfer Code(Credit)

: CUTM1525(2+1+1)

Course Objectives

- To understand the basic concepts and mechanisms of heat and mass transfer under steady state and transient conditions.

Course Outcomes

- Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
- Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
- Explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
- Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

Course Syllabus

Module I (T-3 Hrs.+P-2Hrs.+Pj-2Hrs.)

Introduction to heat transfer: Heat Transfer Mechanisms

Conduction:

Fourier's Law of Conduction, General Heat Conduction Equation in Different Coordinate Systems (No Derivation), One Dimensional Steady State Conduction in Plane Wall, Conduction with Internal Heat Generation.

Practice 1: To find the thermal conductivity of a material by the two slabs guarded hot plate method.

Assignment 1: Assignment on Conduction.

Module II (T-2 Hrs.+P-2Hrs. +Pj-2Hrs.)

Fins and Transient Conduction:

Overall Heat Transfer Coefficients, Unsteady State Heat Conduction, Lumped Heat Capacity System and Lumped Capacitance Method.

Practice 2: To find the thermal resistance of the sample.

Assignment 2: Assignment on Fins and Transient Conduction.

Module III (T-4 Hrs.+P-4Hrs. +Pj-2Hrs.)

Convection:

Thermal Boundary Layer, Principles and Governing Equations, Forced Convection: External Flow over a Flat Plate, Internal Flow Through Pipe, Natural Convection: Vertical & Horizontal Surfaces.

Practice 3: To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.

Practice 4: To verify Newton's Law of Cooling of different materials and different liquids.

Assignment 3: Assignment on Convection.

Module IV (T-2 Hrs.)

Heat Transfer with Phase Change:

Film Wise and Drop Wise Condensation, Boiling Heat Transfer, Regimes of Boiling.

Module V (T-2 Hrs.+P-2Hrs. +Pj-2Hrs.)

Heat Exchangers:

Types of Heat Exchangers, Heat Exchanger Analysis, LMTD, Overall Heat Transfer Coefficient, Heat Exchanger Effectiveness, NTU.

Practice 5: Determination of Effectiveness and Efficiency of Parallel Flow and Counter Flow Heat Exchanger.

Assignment 4: Assignment on Heat Exchangers.

Module VI (T-4 Hrs.+P-2Hrs. +Pj-2Hrs.)

Radiation:

Black Body Emission, Emissive Power, Laws of Radiation, Nature of Black Bodies, Radiation Shape Factor, Radiation Heat Transfer Between Two Surfaces.

Practice 6: To find the emissivity of different material surface.

Assignment 5: Assignment on Radiation.

Module VII (T-3 Hrs.+Pj-2Hrs.)

Mass Transfer:

Introduction, Analogy between heat and mass transfer, Mass diffusion, Fick's law of diffusion, boundary conditions, Steady mass diffusion through a wall, Mass convection.

Assignment 6: Assignment on Mass Transfer.

Text Books:

1. Mahesh M. Rathore, Engineering Heat Transfer , Jones & Bartlett Learning, 2011
2. Yunus A. Cengel & Afshin J. Ghajar, "Heat and Mass Transfer-Fundamentals and Applications", McGraw Hill, 5th Edition 2015
3. Yunus Cengel, Heat And Mass Transfer: Fundamentals And Applications, McGraw-Hill Higher Education, 2014

Reference Books:

1. R.C Sachdeva, Fundamentals of Heat and Mass Transfer

2. R.K. Rajput, Heat Transfer, Laxmi Publication

Basket IV B

Pharmacognosy & Phytochemistry Of Commercially Important Herbs

[Code (Credit): CUTM1167(2-1-0)]

Course Objectives

This course is very critical in imbibing the knowledge of Medicinal and Aromatic Plants. Through this course students will understand the importance of Phytochemistry which actually added therapeutic value to the Medicinal Plants. This course enables analytical thinking of students which will help them in deducing and isolation of the vital phytochemical compounds.

Course Outcomes

Students learning this course consequentially knows about secondary metabolites apart from learning about phytochemistry of significant medicinal plants which will enable them to do sensitive R&D experiments in future.

Course Syllabus
Theory

Module I:

Concept note on commercial medicinal and aromatic plants (MAPs). Collection, cultivation and trade of MAPs. Relationship between conservation sites and richness of MAPs. Commercial MAPs of India. Promoting medicinal plants cultivation as a tool for biodiversity conservation. Yield assessment and cost-benefit analysis. Role of National Medicinal Plant Board (NMPB) in Promotion of MAPs. Marketing of Medicinal Plants: Challenges and Strategies.

Module II:

Methods of extraction, isolation and characterization of natural products. Various separation techniques used for isolation of natural products. Biosynthetic pathways. Primary metabolites, their examples. Secondary metabolites, various classes of secondary metabolites (e.g. Alkaloids, glycosides, tannins, lignans, saponins, lipids, flavonoids, coumarins etc.).

Module III

Important therapeutic classes: anti-diabetics, hepatoprotectives, immunomodulators, nutraceuticals, natural products for gynecological disorders, anti-cancer, anti-viral (mainly anti-HIV), adaptogens etc.

Module IV

Phytochemistry of Neem: General chemical class and identification tests, specific tests for markers, special reference to alkaloids (nimbin, nimbolide etc.), Phytochemistry of Brahmi: General chemical class and identification tests, specific tests for markers, special reference to bitters (bacosides)

Phytochemistry of Turmeric: General chemical class and identification tests, specific tests

for markers, special reference to phenols (curcuminoids) ,Phytochemistry of Withaniasomnifera: General chemical class and identification tests, specific tests for markers, special reference to steroids (withanolides), Phytochemistry of Andrographis paniculata: General chemical class and identification tests, specific tests for markers, special reference to bitters (andrographolides), Phytochemistry of Ginger: General chemical class and identification tests, specific tests for markers, special reference to phenols (gingerols), Phytochemistry of Garlic: General chemical class and identification tests, specific tests for markers, special reference to phenols (allicin), Phytochemistry of Terminalia Arjuna: General chemical class and identification tests, specific tests for markers, special reference to triterpenes (arjunolic acid)

Module V

Definition, history, scope of Pharmacognosy in indigenous system of medicine; Sources of drugs- Biological, marine, mineral and modern techniques like plant tissue cultures as sources of drugs; Classification of drugs and natural origin- Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs. Demand and supply of crude drugs and their regulations with reference to trade and biodiversity; Adulteration, Quality control and drug evaluation: Significance of Pharmacopoeia standards. Detection of adulteration by organoleptic, macroscopic and microscopic methods

Practical

1) Preparation of extracts of Herbs by successive solvent extraction method to record the percentage yield.

2)Detection of Phytoconstituents such as i) Alkaloids, ii) Steroids, Triterpenoids and their glylosides and Saponins iii) Flavonoids and their glycosides iv) Anthracene Glycosides v) Coumarins vi) Tannins by chemical tests and TLC methods.

3)Extraction and estimation of volatile oils by Clevenger's method (Hydro distillation method).

4)Isolation and Purification of following natural products, (a)Piperine form Black Pepper, (b)Caffeine from Tea Powder, (c) Eugenol from Clove oil. Isolation of natural products by column chromatography.

5) TLC figure print profiles of following medicinal plants with special emphasis on their marker compounds, (a) Withania somnifera, (b) Bacopa monnieri, (c) Curcuma longa, (d) Glycyrrhiza glabra.

Suggested Readings

Theory

E-content: www.nmpb.nic.in/

Textbook of Pharmacognosy and Phytochemistry Jarald, Edwin E. and Edwin JaraldSheeja

Textbook of Industrial Pharmacognosy, Kalia, A.N

Pharmacognosy and Pharmaco biotechnology Ashutosh Kar

Trease and Evans Pharmacognosy, Evans, W.C.

Pharmacognosy Kokate, C.K A and Purohit, A.P

Practical

Natural Products: Aa laboratory guide by Raphael Ikan, Academic Press.

Pharmacognosy by C.K. Kokate , Publisher: Nirali Prakashan

Pharmacognosy by Trease & Evans

Pharmacognosy & Phytochemistry by Vinod Rangari

Chemistry of Natural Products: A Laboratory Handbookh by Krishnaswamy NR.

Ayurveda & Fermentation Technology

[Code (Credit): CUTM1168 (1-2-0)]

Course Objective: To understand the basics of ancient Ayurvedic drug formulations through standard texts such as Bhaishajya Kalpana & Sarangadhara Samhitha.

Course Outcome: Through this course students will get both theoretical and practical knowledge of various drug dosage forms and preparation of different traditional medicines such as Kashya (decotions), Lehyas (creams/ointments), oils infused with medicinal values etc.

Theory

Module I

Definition of Bhaishajya Kalpana, Mana paribhasha (Introduction, measurements given in AFI- I)

Module II

Collection, storage and preservation of raw material.

Module III

Introduction to various dosage forms with Principles and procedures in mixtures, solutions, Emulsions, Churnas, Kwath churnas, Powders (Bhasmas etc.), external preparations, suppositories, basti, asavarishta, vati, gutika etc.

Module IV

Sandhana kalpana [Definition, types-names (description of Asavarista only), method, parikshavidhi, dose, anupana, shelf- life, use, packing and storage.

Module V

Definition of Ayu and Ayurveda with introduction to Ashtanga Ayurveda. History of Ayurveda definition and importance of Padartha vignana. Importance and complete information of daily routines, practices food regime etc. Complete information about basics of Vata, Pitta and Kapha, importance of food and its practice.

Practical

1. Preparation of Kwatha/Kashya
2. Quality parameters of Kashaya
3. Preparation of Medicated Taila/Oils
4. Preparation of Medicated Lehya
5. Preparation of Asava and Arista.

Suggested Readings

Bhaishjya Ratnavali

Sharangadhara Samhita

Regulations & Certifications of Herbal Drugs

[Code (Credit): CUTM1169(3-0-1)]

Course Objectives

- This course emphasizes on the mandatory legal procedures which need to be implemented before manufacturing a drug.

- To give the basic description of the organizations and authorities involved in the certification of organic products. To give knowledge on different certifications

Course Outcomes

- Students will understand the role of Licensing authorities in enactment of the Good Manufacturing practices and surveillance of the clinical trials.
- Students undertaking this elective course will have good knowledge of the organic certifiers and the process of obtaining relevant certificate for the validation of their products.
- This course is particularly useful for students planning their career in organic farming sector as employees or self-entrepreneurs.

Course Syllabus

Theory

Module I

Licensing authorities, Licences for herbal products E.g.: Ayurveda, Proprietary medicine, consumer care etc., Drugs and cosmetic acts, Manufacturing licenses and its importance, Manufacturing practices and its importance.

Module II

FSSAI Rules and Regulations, Standards (BIS/EU/) & Clinical Trails:

FSSAI introduction, categories under FSSAI in detail, Ingredients (herbal and non-herbal) and its limits as per FSSAI, Licensing as per FSSAI, CDSCO and its role in clinical trials, Types of clinical trials, Claim substantiation and documentation. BIS , EU , Ref books, BIS web links, EU web link, EFSA Guidelines, AAFCO, National institute of Nutrition (web link). FSSAI FOOD SAFETY AND STANDARDS REGULATIONS 2016.

Module III

HACCP/HALAL/Organic Certifications/Fair Trade

Organic certification- Purpose & Requirements-Global Organic regulatory bodies-National Organic Program (NOP)/USDA Organic-National Program for Organic Production (NPOP)-ECOCERT- COSMOS.

Module IV

Non-GMO Project Product Verification Program-Kosher Certification-Hallal Certification-Hazard analysis and critical control points & ISO 22000. Fairtrade Certification-Vegan Certification-Good Manufacturing Practice Certification (CGMP).

MODULE V

Phytochemicals- new drug class regulated in India; Definition- Phytopharmaceutical Drug; Difference between tradition medicine (Ayurveda, Siddha, or Unani) and Phytopharmaceutical; Process flow of Phytopharmaceutical Drug, Regulatory requirements for phytopharmaceutical drug, Regulatory authority- Central Drugs Standards Control Organization (CDSCO). Regulatory provisions for phytopharmaceuticals and regulatory submission requirements for scientific data on quality, safety and efficacy.

Suggested Reading

1. Drugs and cosmetic act 1945
2. Web : https://archive.fssai.gov.in/home/about-us/introduction.html
3. Objective Food Science and Safety standards ,by Prabodh Halde and sanjeev Sharma (Author)
4. https://cdsco.gov.in/opencms/opencms/en/Home/(web series)
5. A guide to Ayurvedic clinical practice by Dr.Vasant Patil, Chaukambha AyurvedicPratishtan
6. Objective Food Science and Safety standards ,by Prabodh Halde and sanjeev Sharma (Author)
7. https://cdsco.gov.in/opencms/opencms/en/Home/(web series)
8. A guide to Ayurvedic clinical practice by Dr.Vasant Patil, Chaukambha AyurvedicPratishtan
9. Essentials of Botanical Extraction-Principles and Applications: by Mandal SC et al., 2015, Elsevier Inc
10. Extraction technologies for medicinal and aromatic plants, International centre for science and high technology. Edited by Sukhdev Swami Handa, Suman Preet Singh Khanuja, Gennaro Longo, Dev Dutt Rakesh., 2008, ICS-UNIDO.

Material Science of Excipients and Additives

[Code (Credit): CUTM1170 (2-0-1)]

Course Objective: The student will be able to identify a range of excipients and additives. They will learn about their uses and suitability with different pharmaceutical formulations.

Course Outcome: The student will be able to design necessary pre-formulation studies. Also will learn about appropriate excipients and additives required to achieve desired physical properties of the pre-formulation.

Course Syllabus

Module I: Pre-formulation Studies

- Theory: Pre-formulation Studies - Introduction to pre-formulation, goals and objectives, study of physicochemical characteristics of drug substances. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism. Chemical Properties - Hydrolysis, oxidation, reduction, racemization, polymerization BCS classification of drugs & its significant. Application of pre-formulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.
- Project: Write a review report on a drug exhibiting polymorphism (drug of phytochemical origin).

Module II: Tablets

- Theory: Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and

processing problems. Equipment's and tablet tooling. Tablet coating - Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. c. Quality control tests: In process and finished product tests. Liquid orals - Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging - Evaluation of liquid orals official in pharmacopoeia.

- Project: Write a review report on recent development in tablet coating agents (citations used should not be older than 5 years).

Module III: Capsules

- Theory: Hard gelatin capsules - Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. Soft gelatin capsules - Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.
- Project: Write a review report on key differences between hard gelatin and soft gelatin capsules (with reference to the materials used in preparation of hard/soft gelatin).

Module IV: Pellets

- Theory: Introduction, formulation requirements, palletization process, equipment's for manufacture of pellets. Parenteral definition, types, advantages and limitations. Pre-formulation factors and essential requirements, vehicles, additives, importance of isotonicity.
- Project: Write a review report on vehicles and additives for parenteral dosage forms.

Suggested Readings

1. Liberman, H. A., Lachman, L., & Schwartz, J. B. (2005). Pharmaceutical dosage forms: Tablets volume-2. Marcel dekker, New York, 2.
2. Banker, G. S., Siepmann, J., & Rhodes, C. (Eds.). (2002). Modern pharmaceutics. CRC Press.

3. Remington, J. P. (2006). *Remington: The science and practice of pharmacy* (Vol. 1). Lippincott Williams & Wilkins.
4. Allen, L., & Ansel, H. C. (2013). *Ansel's pharmaceutical dosage forms and drug delivery systems*. Lippincott Williams & Wilkins.

Pharmacology-Phyto

[Code (Credit): CUTM1171 (2-1-0)]

Course Objective

The student will be able to identify a range of drugs used in medicine and discuss their mechanisms of action.

Course Outcome

The student will be able to report the clinical applications, side effects and toxicities of drugs used in medicine.

Course Syllabus

Module I: Pharmacology basics and CNS drugs (8h + 6h)

- **Theory**: Introduction, Definition & scope of Pharmacology and Principles of general Pharmacology, Route of Drug Administration, Brief Knowledge of following - CNS depressants, Sedatives, Antiepileptic.
- **Practice**: (Virtual Lab: http://heb-nic.in/Ex-Pharm)

    1. Introduction to experimental pharmacology.
    2. Commonly used instruments in experimental pharmacology.
    3. Study of common laboratory animals.
    4. Maintenance of laboratory animals as per CPCSEA guidelines.
    5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
    6. Study of different routes of drugs administration in mice/rats.

Module II: Different classes of drugs and their pharmacology

- **Theory**: Brief Knowledge of following - Antipyretics, Analgesics, Antihypertensive, Anticoagulant, Haemopoetic,
- **Practice**: (Virtual Lab: http://heb-nic.in/Ex-Pharm)

    1. Study of effect of hepatic-microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
    2. Effect of drugs on ciliary motility of frog oesophagus.
    3. Effect of drugs on rabbit eye.

Module III: Different classes of drugs and their pharmacology II

- **Theory**: Brief Knowledge of following -Bronchodialators, Expectorants, Digestants, Antacids, Laxatives.

- **Practice**: (Virtual Lab: http://heb-nic.in/Ex-Pharm)

    1. Effects of skeletal muscle relaxants using rota-rod apparatus.
    2. Effect of drugs on locomotor activity using actophotometer.
    3. Anticonvulsant effect of drugs by MES and PTZ method.

Module IV: Pharmacology of different classes of drugs and posology

- **Theory**: Brief Knowledge of following - Diuretic, Antidiabetic, steroids, Contraceptives, Antibiotics, Aoushadha Suvan kala, Anupana- its importance, Posology.
- **Practice**: (Virtual Lab: http://heb-nic.in/Ex-Pharm)

    1. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
    2. Study of anxiolytic activity of drugs using rats/mice.
    3. Study of local anaesthetics by different methods.

Suggested Readings

1. Harvey, R. A., Clark, M., Finkel, R., Rey, J., & Whalen, K. (2012). *Lippincott's illustrated reviews: Pharmacology*. Philadelphia.
2. Katzung, B. G. (2012). *Basic and clinical pharmacology*. Mc Graw Hill.

3. Dale, M. M., & Haylett, D. G. (2013). *Rang & Dale's Pharmacology Flash Cards Updated Edition E-Book*. Elsevier Health Sciences.
4. Tripathy, K. D. (2018). Essentials of Medical Pharmacology. 8th ed. *New Delhi: Jaypee Brothers*.

Advanced Separation Technologies and Downstream Processing

[Code (Credit): CUTM1172 (2-2-0)]

Course Objectives

To improve their knowledge in Extraction Technology which is a valuable skill. To familiarise with different advanced extraction techniques developed to date

To improve the existing practical knowledge of students in extraction technology.

To introduce more sophisticated and sensitive extraction techniques such as Super critical Fluid Extraction and Microwave assisted extraction techniques.

Course Outcomes

- This is another vital course which will impart new skill in the students. By learning this course students will know about different extraction techniques and can perform their own extractions using different herbal materials. While experimentation students will choose specific extraction technique depending on their formulation and medicinal plants used for extraction. Hands on experience on advanced instruments will enable them to perform well at industrial level which improve strength of their CV.

Course Syllabus

Theory

Module I

Introduction to extraction of Medicinal Plants-General Methods of Extraction -Steps Involved in the Extraction. Maceration, Percolation and Infusion Techniques for the Extraction-Decoction and Hot Continuous Extraction Techniques.

Module II

Selecting an appropriate extraction method, Extraction methods for Essential Oil-Counter-current Extraction-Aqueous Alcoholic Extraction by Fermentation- Microwave assisted Extraction- Pressurized extraction techniques.

Module III

Enzyme extraction, Molecular Distillation. Supercritical Fluid Extraction-Ultrasound Extraction (Sonication)

Module IV

Subcritical Fluid Extraction Green Extraction-Phytonics Process-Extraction Process Design and Optimization Using Design of Experimental Approach (DOE).

Practical

1. Super Critical Fluid Extraction of Pepper

2. Super Critical Fluid Extraction of Turmeric

3. Separation of essential oil by SCF technique Clove oil

4. Separation of essential oil by SCF technique Zinger oil

5. Preparation of water extract of Amla fruit by Microwave assisted extraction.

Suggested Readings

Essentials of Botanical Extraction-Principles and Applications: by Mandal SC et al., 2015, Elsevier Inc

Extraction technologies for medicinal and aromatic plants, International centre for science and high technology. Edited by Sukhdev Swami Handa, Suman Preet Singh Khanuja, Gennaro Longo, Dev Dutt Rakesh., 2008, ICS-UNIDO.

Suggested Readings Practical

Essentials of Botanical Extraction-Principles and Applications: by Mandal SC et al., 2015, Elsevier Inc

Packaging Technologies

[Code (Credit): CUTM1173 (2-0-1)]

Course Objective

They came to know about the labelling requirements and packaging guidelines for Drugs and Cosmetics.

Course Outcome

The student will be able to identify suitable packaging material for the given formulation. Also will be able to determine the testing required for packaging evaluation.

Course Syllabus

Module I

Fundamentals of packaging - Definition, functions of packaging, types and selection of package, Packaging hazards, interaction of package and contents, materials and machine interface, Environmental and recycling considerations – life cycle assessment Package Design – Fundamentals, factors influencing design, stages in package development.
Packaging materials - Major Plastic packaging materials viz. Polyolefins, Polystyrene, Polyvinylchloride, Polyesters, Polyamides (Nylons), Polycarbonate and newer materials such as High Nitrile Polymers, Polyethylene Napthalate (PEN), Nanomaterials, biodegradable materials – properties and applications, recycling; Wood, Paper, Textile, Glass, Metals – Tin, Steel, aluminum, Labelling materials, Cushioning Materials – properties and areas of application.

Project:

1. Collect and describe about 2 different types of packaging materials.

Module II

Conversion technology - Extrusion – Blown film, cast film, sheet, multilayer film & sheet, Lamination, Injection molding, Blow molding, Thermoforming; Cartoning Machinery, Bottling, Can former, Form Fill and Seal machines, Corrugated box manufacturing machineries, Drums – types of drums, molded pulp containers, Closures, Application of Robotics in packaging. Surface treatment for printing, Printing processes – offset, flexo, gravure and pad printing.

Project:

1. Write a 2-page review on recent developments on robotic packaging.

Module III

Specialty packaging - Aerosol packaging, Shrink and Stretch wrapping, Blister packaging, Anti-static packaging, Aseptic packaging, Active packaging, Modified Atmospheric Packaging, Openable package; Cosmetic packaging, Hardware packaging, Textile packaging, Food packaging; Child resistant and Health care packaging, Export packaging, Lidding, RFID in packaging.

Project:

1. Collect any two types of specialty packaging material and elaborate about them.

Module IV

Testing - Package Testing – Drop test, Impact test, Vibration Test, Stacking and Compression test, Packaging Materials Testing: Mechanical – Tensile, tear burst, impact, compression test, Elongation, barrier properties – WVTR test, Adhesion test, Optical – Gloss, haze and clarity; Chemical Resistance test – solvents and chemicals, solubility test, burning test, solvent retention; Hardness and corrosion test for metals; Clarity and brittleness test for glass.

Project:

1. List the standard values for packaging testing provided in 3 different pharmacopoeia.

Suggested Readings

1. Dean, D. A., Evans, E. R., & Hall, I. H. (Eds.). (2005). *Pharmaceutical packaging technology*. CRC Press.
2. Paine, F. A. (1990). *Fundamentals of packaging*. London: Blackie.
3. Athayle, A.S. (1992). *Plastics in Flexible Packaging*. Multi-tech Publishing Co.
4. Kirwar, M.J. (2005). *Paper and Paperboard Packaging Technology*. Blackwell Publishing.

5. Anon, (1981). Handbook of Package Design Research, Water stem Wiley Intrascience.

Bioanalytical Techniques

Code (Credit): CUTM1174 (2-1-1)

Course Objectives

- This course is introduced to bridge the gap between academics, research and industry. This course begins with a review of basic bio analytical technique and an introduction to general terminologies.
- This course contains bio analytical techniques along with their theory, working principal, common instrumentation and possible applications. This course will be equally beneficial to various scientific areas.
- Students will be exposed to various biological techniques and their applications in identification, isolation of different biological molecules.

Course Outcomes

Students will know the principle and application of various instruments and they can be able to make a strategy molecular technique for the improvement in any trait or its wellbeing based on the techniques learned during this course. This course Can use the knowledge for designing a project for research and execute it.

Course Syllabus

Module-1: Microscopic techniques

Visualization of cells and sub-cellular components by light microscopy and fluorescent microscope, Resolving powers of different microscopes, Electron microscope, Scanning and transmission microscopes, fixation and staining techniques for EM, Scanning probe microscopes: AFM and STM.

Practice: 1 To study and gain expertise on differential and cytological staining techniques.

Module-II: Spectroscopic techniques

Laws of absorption of light, Beer-Lambert's Law, Absorption spectra, Measurement of absorption of light, Factors affecting the absorption properties of chromophores,

Ultraviolet-visible absorption spectroscopy: Principle, Instrumentation and application, Fluorescence spectrophotometry: Principle, Instrumentation and application, Mass spectroscopy: Principle, Instrumentation and application. NMR spectroscopy: Principle, Instrumentation and application

Practice: 2 Demonstration of UV-vis Spectrophotometer.

Module-III: Radiolabeling Techniques

Isotopes and Nature of radioactivity, Radioactive decay, Radioisotopes used in Biology, Detection and measurement of radioactivity, Carbon dating, Geiger-Muller counting and liquid scintillation Counting, Safety guidelines related to Radiolabeling techniques.

Module-IV : Centrifugation techniques

Basic principles of sedimentation, Types of centrifuges, Types of rotors, Preparative centrifugation (Differential & density gradient), Analytical ultracentrifugation. FISH and GISH

Practice:3 To separate proteins on the basis of their size and charge

Module-V:Chromatographic techniques

Principles of chromatography (Adsorption and Partition chromatography), Planar chromatography (Paper and Thin-layer chromatography), Column chromatography,Gas chromatography, Gel permeation chromatography, Ion exchange chromatography,Affinity chromatography,HPLC

Practice:4 To separate the amino acids in a mixture by thin layer chromatography.

Practice:5 Purification of immunoglobulins by affinity chromatography

Module-VI: Electrophoretic techniques

General principles, Electrophoresis of nucleic acids (Agarose gel, pulse-field),Electrophoresis of proteins (SDS-PAGE, native gels)isoelectric focusing and two dimensional gels, Blotting techniques-Southern, northern,Western blotting.

Practice:6 To study the separation of DNA by agarose gel electrophoresis

Module-VII: Electrophysiological Methods

Electrocardiogram (ECG), Positron emission tomography (PET), Magnetic resonance imaging (MRI), Flow cytometry, Gene expression analysis.

Recommended books:

Text Books:

Keith Wilson and John Walker (2009)Principles and techniques of biochemistry and molecular biology.7th Edition,Cambridge University Press, Cambridge, UK.

Reference Books:

1. Keith Wilson and John Walker (2009)Principles and techniques of biochemistry and molecular biology.7th Edition,Cambridge University Press, Cambridge, UK.
2. Donald Voet and Judith Voet. Biochemistry, 4th Edition. (2010). John Wiley and Sons. New Jersey, USA
3. Rodney F Boyer(2012) Biochemistry laboratory: modern theory and techniques.2nd Edition, Pearson Prentice Hall, Boston,USA.
4. R. Katoch(2011) Analytical techniques in biochemistry and molecular biology,Springer, New York.
5. D. L. Spector, R. D. Goldman(2006), Basic methods in microscopy: protocols and concepts from cells: a laboratory manual.Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

Herbal Cosmetic Technology

[Code (Credit): CUTM1175(2-0-1)]

Course Objectives

- This is a skill course which will help students in preparation of cosmetic products.
- This course will elucidate the formulations in detail such that can innovate new products of similar health care objectives.

Course Outcomes

- Through this course students will learn know how and manufacturing of the cosmetic products. Description of several ingredients and their percentage involved in the production process will increase their ease of understanding of cosmetic product manufacturing.

Course Syllabus

Theory

Module I

Introduction to cosmetics- Skin, Hair and Nail Structure & function-Botanicals in Cosmetics

Module II

Cosmetics Ingredients & Nomenclature-Emulsions-Creams & Lotions-Face washes &

Face Masks-Shaving Preparations-Sunscreens- Antiperspirant and Deodorants.

Project I

Preparation of Herbal shaving cream

Project II

Preparation of Herbal face wash

Module III

Make-up preparations - Eye area makeup -Lip care preparations-Nail Preparations-Soaps - Bath & Shower Products-Shampoo & Hair conditioner's-Hair Oils & Hair Sprays-Toothpastes & Mouthwashes-Gels in Hair & Skin Care products.

Project III

Preparation of Herbal Shampoo

Project IV

Preparation of Herbal Hair Oil

Project V

Preparation of Hair Spray using Essential oils

Module IV

Fragrances-Toxicology in Cosmetics-Rheology fundamentals and application in cosmetic formulations-Claims support: Principles and Practice-Cosmetic product Packaging-Consumer testing & Evaluation

Suggested Readings

Handbook of Cosmetic Science and Technology –edited by Andre O. Barel et al., Publisher: Informa Healthcare.

The Chemistry and Manufacture of Cosmetics-edited by Mitchell L. Schlossman, Allured Publishing Corporation.

Harry's Cosmeticology – edited by Meyer R. Rosen

Textbook of Herbal Cosmetics Paperback -by Vimaladevi M.

Herbal Cosmetics Handbook- by H Panda

International Cosmetic Ingredient Dictionary & Handbook- by The Personal Care Products Council.

Quality Assurance & Quality Control of Herbal Products
[Code (Credit): CUTM1176(2-0-1)]

Course Objectives

To enlighten the students regarding the basics of QA & QC arenas of phytopharmaceuticals. To provide standard procedures for maintenance and operation of sensitive equipment's. To give information about the role of Q.A & Q.C in validation and certification of the raw materials and end products.

Course Outcomes

Students will understand the importance and role of the Q.A & Q.C in general maintenance, product and raw material validation. Students will get the benefit of exposure to quality assurance and quality control, which in turn allow them to thrive in areas of the same in herbal industries.

Course Syllabus

Module I

Quality: Concept of quality, nature of product quality, study of various approaches for quality like Deming', Juran, Crosby, Feigenbaum, Shikaw.

Quality income and cost. TQM awards and prizes.

Quality benchmarking, details of international standards (ISO, GMP, GLP, TGM, VAN and

ISI), its need and fact sheet evaluation (should include review or statistics of industries

implemented these standards with those which have not implemented these)

Role of quality audit and quality circle in quality assurance.

Quality assurance and GLP, implementing of GLP in non GLP analytical laboratory.

Process management, project management, strategic development and product development.

Measurement of quality, information and decision making or utilization of data.

Quality operations, its inspection and test used for it.

Human resource and training for quality.

Market survey, customer demand and marketing in addition to supplier and customer relationships.

Quality, society and national culture.

Computerized system- software development, computer applications and quality system.

Requirements of product registration, in India and other countries (USA, UK, Japan and Europe etc)., GLP, ISO 9000, TQM, Quality review and Quality Documentation

Module II

Application of process analytical technology (PAT) in quality assurance

Qualification validation and calibration of equipment. Analytical and bioanalytical method validation

Regulatory requirement in pharmaceutical analysis – US-FDA, ICH, PAC-ALTS: Post approval changes – analytical testing laboratory site etc.

Analysis of drug from biological fluids

Application of analytical methods to product obtained through genetic engineering, Amino acid sequence analysis, tryptic mapping, ion exchange amino acid analysis, isoelectric focusing etc.

Application of analytical methods to product obtained from natural sources (extracts,herbal formulations, isolated compounds, modern herbal formulations) (Compendial methods for evaluation of crude drug and herbal formulation) Dosage form impurity profile and its validation Organization & personnel, responsibilities, training and records. Equipment selection purchase specifications, maintenance, clean in place for analytical department Premises - location, design, plant layout, construction maintenance and utilities and services like gas, water for analytical department

Module III

Introduction to pharmaceutical validation: definition, manufacturing process model, scope of validation, advantage of validation, organization for validation, validation of master plan, types of process validation, design qualification, installation qualification, operational qualification and performance qualification of facilities.

Process validation: prospective, concurrent, retrospective and revalidation,

Process validation of formulations like tablets, capsules, ointment/creams, liquid orals, sterile dosage form which should include following aspects

Personnel and organization

1. Raw materials

2. Equipments (e.g. Dry powder mixers, fluid bed and tray dryers, tablet

3. compression machine, capsule filling machines etc)

4. Area, premises and environment including storage of raw materials to finished

5. products

6. Water (validation of pharmaceutical water system and pure steam),

7. Packaging and labeling controls and its validation

8. Cleaning validation: cleaning of equipment, cleaning of facilities

9. Validation of Integrated lines by media fill test.

10. Validation of HVAC system

Module IV

Vendor Certification. Validation of compressed air, validation of water and air handling systems Validation of existing equipment and utilities validation

Computer system validation including installed softwares, Pharmaceutical development of drug substance and drug product, formulations, manufacture and supply of materials, labeling and presentation, stability and storage, purity, compatibility, disposal.

Suggested Readings

i. E-content:

ii. Text Books:

1. K. Bansal, Chromatography, 1st Ed., Campus books, New Delhi, 2000.

2. K. Bansal, Analytical spectroscopy, 1st Ed., Campus books, New Delhi, 2000.

3. A. Kar, Pharmaceutical drug analysis, 1st Ed., Minerva books, New Delhi, 2001.

4. S. Usharani, Analytical chemistry, 1st Ed., McMillan, New Delhi, 2000.

5. D.H. Shah, SOP; Guidelines, 1st Ed., Business horizons, New Delhi, 1997.

6. D.H. Shah, QA manual, 1st Ed., Business horizons, New Delhi, 1997

7. A.H. Beckett, J.B.Stanlake, Practical Pharmaceutical chemistry-Vol- 1, 4th Ed., CBS, New Delhi, 2004.

8. G.R. Chatwaal, Analytical spectroscopy, 1st, Himalaya publishing house, Mumbai, 1996.

9. G.R. Chatwaal, Analytical chromatography, 1st, Himalaya publishing house, Mumbai, 1996.

10. M. Parkany, Quality assurance and TQM for analytical laboratory, Royal society of chemisty, New Delhi,1995

Plant Biotechnology

[Code (Credit): CUTM1177 (2-1-1)]

Course Objectives

- To understand the basics principles of plant sciences and molecular biology and their integration towards trait improvement in plants.
- To have a thorough knowledge of laboratory techniques used in plant biotechnology.
- To understand the industrial applications of biotechnology in developing new products.
- To undertake research in plant biotechnology.

Course Outcomes

- The students will understand the concepts and techniques of plant biotechnology and their applications in crop plants.
- They can get job opportunities in agribusiness, private companies, industries, universities and research laboratories.
- They can pursue higher studies and research in the field of plant biotechnology.

Course Syllabus

Module I: Basics of Tissue Culture

History, scope, concept of cellular differentiation and Totipotency, Cell culture media and sterilization techniques, Callus culture, nodal and tip culture, Protoplast and Embryo culture, Embryo culture and embryo rescue, protoplast isolation, culture and plant regeneration

Practice: 1. Preparation of tissue culture media
2. Direct Organogenesis: Shoot tip culture

Module II: Applications of Plant Tissue Culture

Somatic embryogenesis, Somaclonal variation and crop improvement, Germplasm conservation, Production of Secondary metabolites through Tissue culture, Industrial applications.

Practice: Micropogation techniques

Module III: Recombinant DNA technology

Genomic DNA & plasmid DNA isolation and purification, construction of recombinant DNA and expression cassettes, Transformation (mobilization of vectors into competent bacteria), selection and analysis of recombinant clones, genomic DNA and cDNA libraries.

Practice: DNA isolation and purification

Module IV: Genetic Engineering in Plants

Vector mediated Gene transfer, Molecular basis of crown gall and hairy root diseases, features of Ti and Ri plasmids, mechanism of T-DNA transfer, role of virulence genes, vectors based on PTi & PRi, binary and co-integrate vectors, optimized protocols for Agrobacterium-mediated genetic transformation, physical and chemical methods of gene transfer.

Practice: 1. Callus induction

2. Agrobacterium mediated gene transfer in plants

Module V: Methods of Gene transfer in plants

Direct gene transfer methods (particle bombardment/ micro projectile / biolistic, electroporation, microinjection, liposome mediated, silicon carbide fibers), chemical methods (PEG - mediated, calcium phosphate co-precipitation), transgenic monocots and dicots via direct gene transfer, in plant transformation. Integration and fate of transgene, precision of transgene integration by site-specific.

Module VI: Applications of Genetic Engineering

Transgenic plants for disease resistance, nutritional improvement, herbicide tolerance, Long shelf life, edible vaccines.

Module VII: Gene silencing in plants

Antisense RNA technology: Antisense RNA, construction of antisense vectors, applications of antisense technology. Gene silencing: causes (DNA methylation, homology-dependent suppression by antisense gene), strategies for avoiding gene silencing, methods of inducing gene silencing and its application. Regulatory RNA molecules (si RNA and miRNA), RNAi technology and its applications in plants.

Text books:

Glick, B. R. and Pasternak (2003). Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, Washington, D. C., USA.

Kyte, L. and Kleyn, J. (1996). Plants from Test Tube to: an Introduction to Micro propagation, 3rd Ed. Timber press, Port land, USA.

Reference Book

Pollard, W. J. and Walker (1990). Plant Cell and Tissue Culture Vol VI. Humana press Clifton, USA.

Good Manufacturing Practices-Herbal Industry

[Code (Credit): CUTM1178(2-0-1)]

Course Objectives

To provide knowledge on GMP ‘s and elucidating their impact on production quality. To introduce the concept of quality standards in terms of ISO-9000 and quality audit. To enlighten the issues in relevance to Hazard analysis and critical points.

Course Outcomes

Students studying this course will understand the necessity of GMP’s. They will know how to maintain the quality through the audits and allow them to maintain homogenous quality throughout the production line.

Course Syllabus

Theory

Module I

Guidelines for the manufacture of herbal medicines - Quality assurance in the manufacture of herbal medicines, Good manufacturing practice for herbal medicines, Airlock, Clean area, Critical operation, cross-contamination, Calibration, Pipe work, light fittings, ventilation points, other services like Sanitation and hygiene.

Module II

Qualification - Contract production and analysis, Self-inspection, Personnel, Training, Personal hygiene, Premises, Equipment, Materials, Documentation, Batch number (or lot number), Batch records, In-process control, Intermediate product, Master formula, SOP, OCP, HIRA, Good practices in production, Packaging, Packaging material, Qualification, Good practices in quality control.

Module III

Validation – Introduction, Basic concepts, types and stages of validation, validation master plan (VMP), equipment validation. Concept of URS, DQ, IQ, OQ & PQ and process-types. Prospective, concurrent and retrospective validation & revalidation.

Module IV

Quality assurance in Herbal Drug Industry concept of TQM, GLP, ISO-9000, Quality audit, Suppliers’ audits and approval, Auditing of Storage area, Weighing areas, Production area, Intermediate and bulk products and finished products, HACCP in traditional system of medicine.

Suggested Readings

Good Manufacturing Practices for pharmaceutical products. In: WHO Expert Committee on Specifications for Pharmaceutical Preparations. Twenty second report. Geneva, World Health Organization, 1992, Annex 1 (WHO Technical Report Series, No. 823).
Validation of analytical procedures used in the examination of pharmaceutical materials. In: WHO Expert Committee on Specifications for Pharmaceutical Preparations. Thirty-second report.
Geneva, World Health Organization, 1992, Annex 5 (WHO Technical Report Series, No. 823). General guidelines for methodologies on research and evaluation of traditional medicine.
Geneva, World Health Organization, 2000. 6. Quality control methods for medicinal plant materials. Geneva, World Health Organization, 1998.

Plant Design and Operation for Herbal Drugs

[Code (Credit): CUTM1179(2-0-1)]

Course Objectives

- This course provides comprehensive view of a plant where bulk production of herbal products occurs.
- Designing of the plant for effective production is another major objective of this course

Course Outcomes

- This course enables students to do amalgamation of their herbal production knowledge to aspects of Chemical Engineering and design of a production process sheet such that they transform into industrial production plant designers.

Course Syllabus

Theory

Module I

- General design considerations, Process design development, Layout of plant items, Flow sheets and PI diagrams, Economic aspects and Optimum design, Practical considerations in design and engineering ethics. Water: Water resources, Storage and characterization, Conditioning.

Module II

- Steam - Boilers, Steam Handling and distribution, Steam nozzles, Condensate utilization, Steam traps, Flash tank analysis, Safety valves, Pressure reduction valves, Desuperheaters. Air - Air compressors, Vacuum pumps, Air receivers, Distribution systems, Different types of ejectors, Air dryers. Energy Conservation - Analysis of scope and potential for energy conservation, Good housekeeping practice, Thermal insulation, Efficiency improvement in boilers, furnaces and heat recovery techniques, Energy conservation in HVAC systems, Electrical energy conservation; analysis of motor, analysis of pumps, Process integration as a measure of energy conservation, Optimization of steam system,

Module III

- Energy saving opportunities with compressed air systems and cooling towers. Analysis of Cost estimation - Factors affecting Investment and production costs, Estimation of capital investment and total product costs, Interest, Time value of money, Taxes and Fixed charges, Salvage value, Methods of calculating depreciation, Profitability, Alternative investments and replacements.

Module IV

- Optimum Design and Design Strategy: Break-even analysis, Optimum production rates in plant operation, Optimum batch cycle time applied to evaporator and filter press, Economic pipe diameter, Optimum insulation thickness, Optimum cooling water flow rate and optimum distillation reflux ratio.

Suggested Readings

- Peters, M.A. and Timmerhaus, K.D., Plant Design and Economics for Chemical Engineers, McGraw Hill (2003).

- Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill (1982). Ulrich, G.D., A Guide to Chemical Engineering Process Design and Economics, John Wiley & Sons (1984).
- Nagabhushan Raju, K., Industrial Energy Conservation Techniques: Concepts, Applications and Case Studies, Atlantic Publishers & Distributors (2007).

Statistical Quality Control & Design of Experiments

[Code (Credit): CUTM1180(2-0-1)]

Course Syllabus

Module I

Measures of Central Tendency, Measures of Variations, Statistical Distribution, Theory of Probability- Binomial, Poison and Normal Distribution

Module II

Central Limit Theorem, Regression Analysis, Analysis of variance (ANOVA) in Factorial Experiments

Module III

Theory of Sampling, Hypothesis Testing, Parametric and Non-parametric tests

Module IV

Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors.

Suggested Readings

Douglas.C. Montgomery, “Introduction to Statistical quality control”, 4th edition, John Wiley 2001.

John.S. Oakland. “Statistical process control”, 5th edition, Elsevier, 2005

Connor, P.D.T.O., “Practical Reliability Engineering”, John Wiley, 1993

Grant, Eugene .L “Statistical Quality Control”, McGraw-Hill, 1996

Monohar Mahajan, “Statistical Quality Control”, Dhanpat Rai & Sons, 2001.

Gupta. R.C, “Statistical Quality control”, Khanna Publishers, 1997.

Design and Analysis of Experiments, Douglas C. Montgomery, 5th Edition Wiley India Pvt.

Quality by Experimental Design, Thomas B. Barker, Marcel Dekker, Inc ASQC Quality Press.1985.