The following colour represents the syllabus revision, skill, employability and entrepreneurship.

Yellow : Syllabus Revision

Green   : Skill

Pink   : Employability

Sky   : Entrepreneurship

1	CUTM1001	**Differential Equations and Linear Algebra**	**3 (2+0+1)**

Course Objectives
- Introduce students to how to solve linear Differential Equations with different methods.
- 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.
- Introduce students how to solve first order and second order differential equations

Learning Outcomes

Upon successful completion of this course, students will be able to:
- Understand the importance of linear functions in mathematics.
- Solve systems of linear equations using Gauss- elimination to reduce to echelon form.
- 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.
- <mark>Students will develop skill to solve linear Differential Equations with different methods</mark>

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:

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

Project 4:

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

Module V:

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

Module VI:

Eigen values and Eigen vectors of a matrix.

Project 5:

(i) Find the limit states of the Markov process model.

(ii)Find the growth rate in the Leslie model

Module-VII:

Symmetric, Skew-Symmetric, Orthogonal Matrices and Properties

Project 6:

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?

Text Books:

- Advanced engineering mathematics by Erwin Kreyszig, 8th edition [Chapter-6 (6.1-6.6), Chapter-7 (7.1,7.2)]
- Higher Engineering by B.V. Ramana [Chapter-8(8.1,8.2,8.9,8.10,8.21), Chapter-9 (9.2,9.3,9.5)]

Reference Books:

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

Courseware link:

http://courseware.cutm.ac.in/courses/differential-equations-and-linear-algebra/

2	CUTM1002	Linear Algebra & Vector Calculus	3 (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.

Learning Outcomes

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

•Students will develop skill to solve the system of linear equations appearing in the problems of electrical engineering, mechanical engineering etc.

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

•Solve systems of linear equations using Gauss- elimination to reduce to echelon form. To solve the system of linear equations appearing in the problems of electrical engineering, mechanical engineering etc.

Course Syllabus

Module I:

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

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

	Module II:		

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

Project-2
Find the respective currents flowing through an electrical network using Kirchhoff current law.

Module III:
Eigenvalues and Eigen vectors.

Project-3
(i)Find the limit states of the Markov process model. (ii)Find the growth rate in the Leslie model

Module IV:
Symmetric, Skew-Symmetric and Orthogonal Matrices.

Project-4
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:
Complex matrices, Hermitian, skew-Hermitian, and Unitary Matrices.

Project-5
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:
Inner Product (Dot Product), Vector Product (Cross Product),Triple Scalar Product. Vector and Scalar Functions.

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

Project-6
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

Courseware link:

3	**CUTM1003**	**Complex Analysis, Numerical Methods**	**3 (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.

Learning Outcomes

- **U**pon 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.
- To acquire the skill of evaluating contour integrals using Cauchy's integral formula and Cauchy's integral theorem
- 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:

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

Module II:

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:

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:

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:

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:

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:

Runge-Kutta 2nd & 4th order methods.

Project-6:

Finding out Numerical solutions of differential equations using Runge-Kutta 2nd & 4th 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

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

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

Courseware link:

http://courseware.cutm.ac.in/courses/complex-analysis-numerical-methods/

4	CUTM1004	Discrete Mathematics	3 (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.

Learning 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.
- Students will be skilled in mathematical reasoning in order to read, comprehend and construct mathematical arguments as well as to solve problems, occurred

Course Syllabus

MODULE-I:

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:

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:

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:

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:

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:

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:

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:

1)   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.

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

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

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

Courseware link:

http://courseware.cutm.ac.in/courses/discrete-mathematics/

5	CUTM1005	Probability & Statistics	3 (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.

Learning 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.
- The students will be skilled to apply probability and statistics in engineering and science like disease modeling, climate prediction and computer networks etc.
- Compute probabilities based on practical situations using the Binomial, Poisson and Normal distributions.

Course Syllabus

Module I: 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:

Mutually Exclusive Events, Dependent and Independent Events. Conditional Probability

Project-2:

A Report on Dependent and Independent Events with Examples

Module III:

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:

Uniform Distribution, Binomial Distribution, Poisson Distribution

Project-4:

Applications of Poisson distribution

Module V:

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:

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

Module VII:

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

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.

Courseware link:

http://courseware.cutm.ac.in/courses/probability-and-statistics-2/

6	CUTM1006	Mechanics for Engineers	3 (2+0+1)

Course Objectives

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

Learning Outcomes

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

- Develop skill in applying laws of mechanics to determine efficiency of simple machines with consideration of friction.
- 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: 1) Engineering Mechanics; Statics and Dynamics by A. K. Tayal, Umesh Publications		
	Reference Books: 2) Engineering Mechanics by S. Timoshenko, D.H. Young and J.V. Rao, Tata McGraw Hill 3) Engineering Mechanics by D.S. Kumar, S.K. Kataria and Sons		
	Courseware link: http://courseware.cutm.ac.in/courses/mechanics-for-engineers/		
7	**CUTM1007**	**Optics and Optical Fibres**	**3 (2+0+1)**

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.

Learning 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.
- Acquire skill in finding applications of laser, and optical fiber in the field of engineering and technology

Course Syllabus

Module I:

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:

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:

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, Refractive index of the liquid

Module IV:
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 Law To 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:
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:
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:
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.

Courseware link:

http://courseware.cutm.ac.in/courses/optics-and-optical-fibers/

| 8 | CUTM1008 | **Applied Analytical Chemistry** | **3 (2+0+1)** |

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 analysing a specific compounds in an environmental matrix

Learning 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 samples.
- Students will be skilled to demonstrate and perform various chemical analysis and determination of biochemical parameters for research and quality check.

Course Syllabus

Module-I:

Water softening processes: Lime-Soda, Zeolite and Ion exchange methods. Removal of DO and dissolved CO_2 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:

Determination of hardness of water by EDTA method; Determination of alkalinity of water; Determination of Dissolved Oxygen in water Determination of Biological Oxygen Demand; Determination of Chemical Oxygen Demand.

Module-II:

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

Practice:

Determination of specific gravity of the soil by using piknometer; Determination of pH and electrical conductivity of soil sample; Determination of moisture content in soil by oven drying method.

Module-III:

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:

Determination of calorific value of a fuel sample by using Bomb calorimeter; Analysis of flue gases by Orsat's apparatus.

Module-IV:

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:

Synthesis of biodiesel by trans esterification process

Module-V:

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

Practice:

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

Module-VI:

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

Module-VII:

Error in Chemical analysis; Types of errors, Accuracy and precision, Absolute and relative uncertainty, mean and standard deviation.

Text Books

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

Reference Books

1) Applied Chemistry By Aruna Kumari-2nd Edition,Paramount publications, 2016
2) Engineering chemistry by OG Palanna,McGrahill Education(India) private Limited, 2009
3) Engineering chemistry by K.Sesha Maheswaramma,Mridula.Chuch.PearsonIndia Education services pvt Ltd, 2016
4) Engineering chemistry by Prasanth Rath,Cengage Learning India pvtLtd, 2013
5) Engineering chemistry by R.V. Gadag, A. Nityananda, Shetty, I.K. International Publishing house, 2006
6) Engineering chemistry –Fundamentals and applications, By Shika Agarwaal- Cambridge University PressEdition,2017

Courseware link:

http://courseware.cutm.ac.in/courses/applied-analytical-chemistry-2/

9	CUTM1009	Applied Engineering Materials	3 (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

Learning Outcomes

After completion of this course students will able to

- Understand the physical/chemical behaviours of materials.
- Acquire skill to select different materials based on their properties and behaviours for a given application.
- Apply vector calculus approach to problems in electric field and magnetic field.
- Students will be skilled in following different methods for nanomaterial

Course Syllabus

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

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

Module VII:
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

Courseware link:

10	CUTM1010	**Environmental Studies**	**3 (2+0+1)**

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.

Learning 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.
- Students will be able to design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.
- Understand different resources such as mineral resources, food resources, water resource, energy resources, natural resources and land resources

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).

Courseware link:

BASKET-II

(Humanities and Management)

(Total Credits: 12; A: 6 credit (Choice); B: 6 credit Compulsory)

1.	CUTM1011	Optimisation Techniques	2 (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

Learning Outcomes

- Students will be skilled 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
- To Create an Engineering design methodology using a mathematical formulation of a design problem to support selection of the optimal design among alternatives

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

2.	CUTM1012	Engineering Economics and Costing	3 (2+0+1)

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

Learning Outcomes

Upon successful completion of this 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.
- Equip students with the skills required to understand cost statements/records of the product and its effect on decision making

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

Courseware link:

3.	CUTM1013	Project Management	3 (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

Learning Outcomes

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

- Develop skill to prepare 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
- Implement project management methodology to initiate and manage projects efficiently and effectively

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.

Reference Books:

- Project Management: A Managerial Process, Clifford F Gray & Eric W Larson, Tata McGrawHill.
- 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).

Courseware link:
http://courseware.cutm.ac.in/courses/project-management/

4.	CUTM1014	**Gender, Human Rights and Ethics**	**3 (2+0+1)**

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.

Learning Outcomes

Upon successful completion of this course, students will be able to:
- Understand 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.
- Sensitisation of how gender, human rights and ethics are significant in organisations

Module-I:

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-II:

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-III:

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.

Reference Books:

- 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.

Courseware link:
http://courseware.cutm.ac.in/courses/gender-human-rights-and-ethics/

5.	CUTM1015	Climate Change, Sustainability and Organisation	3 (2+0+1)

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.

Learning Outcomes
Upon successful completion of this course, students will be able to:
- 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)
- Able to create awareness about the impact of climate change on organisations in performance, growth and sustainability

Module-I:

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-II:

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.

Courseware link:
http://courseware.cutm.ac.in/courses/climate-change-and-sustainable-development/

6.	**CUTM1016**	**Job readiness**	**6 (0+6+0)**
	Course Objectives		

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

Learning Outcomes

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

- Achieve the following scores as a minimum:
  - ➢ IELTS 6.5
  - ➢ Verbal: 60% (average of 10 exams)
  - ➢ Quantitative: 60% (average of 10 exams)
  - ➢ Logical Reasoning: 60% (average of 10 exams)
  - ➢ Develop additional skills (verbal, logical, quantitative and reasoning) required to enhance employability as well as the entrepreneurial ability of the students

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 & Shortcut; 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

Courseware link:
http://courseware.cutm.ac.in/courses/25090/

BASKET-III

Basket III (Smart Stack: Compulsory for all branch of Engineering)

(Total Credits: 25)

1.	CUTM1017	Industrial IOT and Automation	6 (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.

Learning Outcomes

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

Module-I:

Introduction & Architecture:
Theory – What is IIoT and connected world; Difference between IoT and IIoT; Web of things; Architecture of IIoT.
Practice – Simulation of RFID using Matlab/Dymola

Module-II:

Communication Technologies of IIoT:
Theory – Industry standards communication technology (LoRAWAN, ZigBee, OPC UA, MQTT), wireless network communication, security issues in IIoT.
Practice – Demonstration of MQTT communication using Matlab/Dymola; Site visit to Apparel factory in the Bhubaneswar campus; Wireless communication demonstration using Matlab/Dymola.

Module-III:

Visualization and Data Types of IIoT:
Theory – HMI in an IIoT world; Enterprise data for IIoT, emerging descriptive data standards for IIoT.

Practice – Assembling the HMI for IIoT environment using Matlab/Dymola; Measurement of temperature & pressure values of the process using sensors.

Module-IV:

Automation:
Theory – Automation definition, automation pyramid, field level sensors, HMI in an automation process.
Practice – Visualization of diverse sensor data using dashboard (part of IoT's 'control panel'); Wearable sensing for IoT (future user interfaces for IoT - new ways to control and interact with your environment)

Module-V:

Control & Supervisory Level of Automation:
Theory – Programmable logic controller (PLC), Supervisory Control & Data Acquisition (SCADA).
Practice – Simulation of PLC to understand the control concept; SCADA HMI demonstration using Matlab; SCADA simulation using Matlab/Dymola.

Module-VI:

Planning Level & Management Level:
Theory – Manufacturing Execution System (MES), Enterprise Resource Planning (ERP).
Practice – Designing MES system by using Adobe.

Reference Books:

- The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
- Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)

Courseware link:
http://courseware.cutm.ac.in/courses/industrial-iot-and-automation/

2.	CUTM1018	Data Analysis and Visualisation using Python	4 (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

Learning Outcomes
Upon successful completion of this course, students will be able to:
- To create impactful visualization with good story line
- To develop visualization to tell the story.

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 Visualisation using Python Libraries – Different graphs such as Scatterplot, Line chart, Histogram, Bar chart, Bubble chart, Heat maps etc.; Dashboard Basics: Layout, Reporting, Infographics, Interactive components, live updating

Projects List

- COVID 19
- World Development Indicators
- ERP dashboarding
- Details of Social/ Empowerment schemes of Govt. etc.

Courseware link:
http://courseware.cutm.ac.in/courses/data-analysis-and-visualisation-using-python/

3.	**CUTM1019**	**Machine Learning using Python**	**4 (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.

Learning Outcomes
Upon successful completion of this course, students will be able to:
- Students will able to Create and incorporate ML solutions in their respective fields of study

Module-I:

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-II:

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-III:

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-IV:

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.

Reference Books:

- 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.

Courseware link:
http://courseware.cutm.ac.in/courses/machine-learning-using-python/

4.	CUTM1020	**Robotic automation with ROS and C++**	**4 (1+2+1)**

Course Objectives

- To upgrade knowledge levels of robotic application in modern industries
- Project based training

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

- Advanced knowledge on robotic automation
- Understand different types of devices to which robotic modules are connected
- Provide the knowledge about understand various types of robotic applications.
- Industry based project & advanced learning.

Module-I:

Mechanical (Basic Definitions & Brief Discussion) – Introduction to Robotics, Control System, Open Loop & Closed Loop System Role of Mechanical Elements such as Links, Joints, Structure, Kinematics Pairs Mechanisms, Degrees of Freedom, Gears & its types, Belt Drive, Force, Momentum of force, Inertia, Torque, Power, Friction.

Module-II:

Sensor's requirement in robots – Selecting sensors as per the project; Specification checking of sensors; Interfacing of sensor to controllers.

Practice – Tilt, Proximity, Temperature, Humidity, Smoke, Fingerprint; Bluetooth, ESP8266, GPS, GSM

Module-III:

Computer Vision, Machine Learning and Artificial Neural Network in Robotic Image processing to Computer Vision; Image and Video - Processing; Analysis and Interpretation; Imagery intelligence; Distinguish between Computer Vision, Machine Vision & Robot Vision; Introduction and Basic principle of Machine Learning; Artificial Intelligence and Neural Network for Robotics.

Module-IV:

Controllers and output port handling – Concept of 8951 controller; Concept of Arduino and concept of Raspberry Pi.

Practice – Port handling of 8951; Port handling of Arduino; Port handling of Raspberry Pi.

Module-V:

Sequential robot control – Designing of sequential robot control system; Writing of programs in different programming languages Controlling of input/output devices.

Practice – Programming of controllers with different programming languages; Designing of sequential control robot.

Module-VI:

ROS & C++ - What is Ubuntu & ROS; Requirement and application of ROS; ROS based simulation of Turtlbot; Adding of robot with wheel & sensor. Placing robot inside Gazebo.

Practice – Ubuntu basic command; Installation of Ubuntu, ROS & Gazebo; Turtlbot control application; Gazebo based robot control and simulation; Python and C++ based programming to control robot; Virtual LAB : Using ROBOMASTER (AWS)

Projects List

- Mobile controlled robot
- Autonomous operated robot.
- Location targeted robot

Courseware link:
http://courseware.cutm.ac.in/courses/25657/

5.	CUTM1021	**Basics of Design Thinking**	**2 (0+0+2)**

Course Objectives

- Orient the participants on the basics of the design thinking process
- Familiarize participants with the elements and application of Design thinking

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

- <mark>Apply the design thinking process to innovative problem solving</mark>

Module-I:

Basics of Design Thinking, Why Design Thinking, Design Thinking Mindset (Inspiration, Ideation and Implementation) Design thinking process, (Empathy, Define, Ideate, Prototype, Test). Cases of application of Design thinking approach (Intuit, IDEO, Infosys, IBM, Google, Apple, Jubilant Foods). This will be in a flip class mode followed by a workshop, to be conducted by an external expert and a faculty anchor.

Module-II:

Executing a Design Thinking Project- Apply Interviewing and empathy building technique, Drawing inferences from the observations, Defining a point of view, Ideation process, developing and testing prototypes and writing a story of a minimum viable solution.

Projects List

- Develop a customer friendly insulin pump design (teams of 3 students to be graded on the application of the process, story boarding and the final design elements).
- Develop a new customer experience for buying a diamond ring online (teams of 3 students to be graded on the application of the process, story boarding and the final design elements).
- Develop a new disease monitoring device for health workers working in remote areas. (teams of 3 students to be graded on the application of the process, story boarding and the final design elements).
- Designing an integrated machinery for end to end functions for small and marginal farmers.

Reference Books:

- Tom Kelly & Jonathan Littman (2001). "The Art of Innovation" Broadway Publication

Courseware link:
http://courseware.cutm.ac.in/courses/basics-of-design-thinking/

6.	CUTM1022	**System Integration with DYMOLA**	**2 (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.

Learning 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.

Module-I:

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 behaviour; 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-II:

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-III:

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

Courseware link:
http://courseware.cutm.ac.in/courses/system-integration-with-dymola/

7.	CUTM1023	**Smart Engineering Project (G2M)**	**3 (0+0+3)**

Course Objectives

- The main objective of this course is that students from various branches can learn different tools and collaborate together to build a smart live project.
- To make the centurion's think beyond engineering.
- To provide the platform to express the imagination to reality.
- To acculturat*e the* diversity in engineering.

- To make the centurions industry ready.

Learning Outcomes

- Learn the new tools and use them to solve some current problems in their respective areas.
- Be able to learn current industry software's and work on projects based on multidisciplinary fields.
- Can able to explore the engineering more conceptually manner.
- Can able to discover the engineering as a quality product outcome.
- Can able to work with the diversity in present industries scenario.

Course Syllabus

- Inter Disciplinary
- Product Based
- Industry 4.0
- Go to Market Based

Projects List

- Analysis Design of G+10 Building using STAAD Pro
- Automated water irrigation controller for rice field
- Automatic Microgrid System
- Automation in Light and Fan in Classroom
- Speed Control Control Of Dc Motor using Arduino
- Bench Tapping Machine
- Modular E-Rikshaw Design using Catia
- Renewable Energy using Compressor
- Wireless Control Robotic car through MATLAB GUI
- Water Level and Temperature Indicator
- Speech Recognition using Python
- IOT Based Air Pollution Quality Monitoring with ESP8266
- Plant Disease Detection using Image Processing
- IOT Based Air Quality and Monitoring By Using Arduino
- Automatic agriculture field monitoring device
- IOT Based Weather Station Using GY-BME280 Sensor Module and ESP8266-12E Node MCU LUA Wi-Fi Module
- Bluetooth Controlled Car Using ARDUINO
- Crimes Against Women in India
- A Presentation on Analysis of QUAD COPTER
- Collecting Data and Visualizing of a Mobile Sensors of Android Device
- Manufacturing of Knuller Tool
- Smart Product Sanitization and Packaging System

Products List

- Insulin Pump Prototype Design
- Electronic Controller Design
- Battery Management System Design
- Poly House

- Apparel Tracking using Apriso webserver
- Android app development using android studio and Java
- Modular E-Rickshaw variant Design
- Autonomous Navigating Vehicle
- Smart Transformer Control Panel Design
- 3-Phase BLDC Motor Driver Design

Courseware link:

http://courseware.cutm.ac.in/courses/smart-engineering-project-g2m/