CBCS COURSE STRUCTURE AND SYLLABI

B. Tech. (Agriculture Engineering)

2022-2023 Batch

CENTURION UNIVERSITY

Shaping Lives...
Empowering Communities...

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

Web Site: - www.cutm.ac.in

BASKET STRUCTURE (Regular B. Tech AG: 4 years)

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	48	Core
	IV.B	Core Engineering Courses	44	Core
	IV.C	Summer Training one month (2*3)	6	Core
V		Domain Courses (Project, Industrial Internship).	28	Choice
		Total Credits	**180**	

BASKET STRUCTURE (Lateral entry B. Tech AG: 3 years)

Basket		**Basket Category**	**Minimum Credits to be acquired**	**Scope**
I		Foundation Courses in Sciences	12	Choice
II		Foundation Courses in Humanities & Management	7	Choice
III		Smart Stack	19	Core
IV	IV.A	Foundation Engineering Courses	29	Core
	IV.B	Core Engineering Courses	39	Core
	IV.C	Summer Training one month (2*3)	6	Core
V		Domain Courses, Industrial Internship	28	Choice
		Total Credits	**140**	

Basket I: Foundation courses in Sciences

Sl. No	**Area**	**Code**	**Course**	**T**	**Pr**	**Pj**
1	Math (5)	CUTM1001	Differential Equations and Linear Algebra	2	0	1
2		CUTM1002	Laplace & Fourier Transforms	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

6		CUTM1925	Calculus	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
Humanities and Management(A)	CUTM1011	Optimisation Techniques	0	2	0
Humanities and Management(A)	CUTM1012	Engineering Economics and Costing	2	0	1
Humanities and Management(A)	CUTM1013	Project Management	2	0	1
Humanities and Management(A)	CUTM1014	Gender, Human Rights and Ethics	1.5	0	1.5
Humanities and Management(A)	CUTM1015	Climate Change, Sustainability and Organisation	1.5	0	1.5
Humanities and Management(B)	CUTM1016	Job readiness	0	6	0

Basket III: Smart Stack (25)

Sl. No	Code	Course title	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.A FOUNDATION COURSES (Total Credit: 48)

Sl. No	Code	Course title	T	Pr	Pj
1	CUTM1048	Digital Signal & Image Processing	2	1	0
2	CUTM1062	Theory of failure analysis using FPA	2	2	0`
3	CUTM1081	Computer Aided Engineering	0	2	1
4	CUTM1091	Theory of Machine	2	1	0
5	CUTM1092	Heat Transfer with FVM	2	1	0
6	CUTM1089	Fluid Mechanics with FVM	2	1	0
7	CUTM1090	Hydraulic machinery	1	1	0
8	CUTM1088	Thermodynamics	2	1	0
9	CUTM1054	Electrical Machines Operation and control	3	1	0
10	CUTM1057	Basic Electrical Engineering	1	1	0
11	CUTM1073	Geotechnical Engg.	1	1	1
12	CUTM1074	Design of structures	1	3	0
13	CUTM1063	Quantity Estimation and Costing	2	1	0
14	CUTM1289	Fundamentals of Soil Science	2	1	0
15	CUTM1290	Fundamentals of Horticulture	1	1	0
16	CUTM1287	Fundamentals of Agronomy	2	1	0
		Total	**26**	**20**	**2**

Basket IV.B CORE AGRICULTURAL ENGG. COURSES (Total Credit: 44)

Sl. No	Code	Course Title	T	Pr	Pj
1	CUTM 2066	Post-Harvest Engineering of Cereals, Pulses and Oil Seeds	2	1	0

2	CUTM1128	Engineering Properties of Agricultural Produce	1	1	0
3	CUTM1129	Watershed Hydrology	1	1	0
4	CUTM1130	Tractor and Automotive Engines	2	1	0
5	CUTM1131	Irrigation Engineering	2	1	0
6	CUTM1132	Tractor Systems and Controls	2	1	0
7	CUTM1133	Farm Machinery and Equipment-I	2	0	1
8	CUTM1134	Agricultural Structures and Environmental Control	1	0	1
9	CUTM1135	Sprinkler and Micro Irrigation Systems	1	1	0
10	CUTM1136	Soil-Water Conservation Engineering and Structure	3	0	1
11	CUTM1137	Watershed Planning and Management	1	1	0
12	CUTM1138	Drainage Engineering	1	1	0
13	CUTM1139	Farm Machinery and Equipment-II	2	0	1
14	CUTM1140	Post-Harvest Engineering of Horticultural Crops	1	0	1
15	CUTM1141	Groundwater, Wells and Pumps	2	1	0
16	CUTM1142	Tractor and Farm Machinery Operation and Maintenance	0	2	0
17	CUTM1143	Dairy and Food Engineering	2	0	1
		Total	**26**	**12**	**6**

Basket IV.C SUMMER TRAINING (Total Credit: 6)

Sl. No	Code	Course Title	T	Pr	Pj
1	CUTM1939	SUMMER TRAINING-I	0	0	3
2	CUTM1940	SUMMER TRAINING-II	0	0	3

Basket V: Domain course (Total Credit: 28)

1. SMART FARM MACHINERY Credits (T-P-P): (6-9-13) 28 Credits

Sl. No	Code	Course Title	T	Pr	Pj
1	CUFM2220	Product Development Brief	0	1	1
2	CUFM2221	Sensor, Actuators and Robot Operating Systems	2	2	0
3	CUFM2222	Farm Machinery Design	2	0	1
4	CUFM2223	Piloting a Drone	1	2	0

5	CUFM2224	PLM using Dassault Tools	1	2	0
6	CUFM2225	Testing of Farm Machinery	0	2	1
7	CUFM2226	Project and internship	0	0	10

2. SOIL AND WATER CONSERVATION THROUGH WATERSHED Credits (T-P-P): (4-11-13) 28

Sl. No	Code	Course Title	T	Pr	Pj
1	CUSW2340	Rainwater Harvesting and Artificial Recharge	1	2	0
2	CUSW2341	Integrated watershed management	2	1	0
3	CUSW2342	Sustainable Watershed	1	2	0
4	CUSW2343	R programming in watershed hydrology	0	2	1
5	CUSW2344	Modelling and Simulation of Watershed Processes	0	2	1
6	CUSW2345	Geo-spatial application in watershed management	0	2	1
7	CUSW2346	Project and internship	0	0	10

3. Food Processing Credits (T-P-P) (3-15-10) Total 28

Sl. No	Code	Course Title	T	Pr	Pj
1	CUFP2310	Processing Technology of Cereals and Millets	1	2	0
2	CUFP2311	Processing Technology of Legumes and Oilseeds	1	2	0
3	CUFP2312	Processing Technology of Fruits, Vegetables, Spices and Condiments	1	2	0
4	CUFP2313	Product Development and Packaging Technologies	0	3	0
5	CUFP2314	Food Standards and Regulations and HACCP Systems	0	3	0
6	CUFP2315	Sensory Evaluation and Nutritional Labelling of Foods	0	3	0
7	CUFP2316	AELP Linked Project and Internship	0	0	10

BASKET-I

Foundation Courses in Sciences

(Total Credits: 17)

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

Course 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

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. **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:** 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:**		

	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. **Course 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. • 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 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 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. **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:** 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. **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:** 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 **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:** 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.

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 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 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 samples Course Syllabus.

Course Syllabus

Module-I:

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:

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 **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:** 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:** http://courseware.cutm.ac.in/courses/applied-engineering-materials/		
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. • **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).

Courseware link:
http://courseware.cutm.ac.in/courses/environmental-science/

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

	• 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. **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:** http://courseware.cutm.ac.in/courses/engineering-economics-and-costing/		
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

Course Outcomes

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

- 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

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.		

Course Outcomes

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

- 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.

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

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

	• To create impactful visualization with good story line **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. **Course 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		

Course 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 **Course Outcomes** Upon successful completion of this course, students will be able to: • Apply the design thinking process to innovative problem solving **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. **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. **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.

Course 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/

BASKET- IV. A

(Foundation Courses in Engineering)

(Total Credits: 48)

1.	CUTM1048	Digital Signal & Image Processing	3 (2+1+0)

Course Outcomes:

- Students will gain knowledge on fundamental concepts of a digital signal and image processing System.
- Students will develop skill of developing new algorithms in signal and image processing Applications.
- Student will develop skill on MATLAB implementation of different signal and image processing techniques.

Course Objectives:

- To teach students time domain,frequency domain,discrete time signals, properties and digital filter design techniques
- To provide knowledge on basic concepts of image and its processing techniques
- To provide knowledge on Enhancement, Restoration, Segmentation techniques
- To provide hand on experience of signal & image processing techniques using MATLAB

Syllabus:

Module I: fundamentals of digital signal processing

Characterization and classification of signals, Z-Transform: Direct Z-Transform, inverse Z-Transform, Properties of The Z-Transform, Linearity, Time Shifting, Scaling, Time Reversal, Differentiation, Convolution, Correlation, Accumulation, System Function of a Linear Time-Invariant System

Practice:

Signal generation using MATLAB.

2. Analysis of LTI system and Z-transform of signal using MATLAB.

Module II: Discrete fourier transform & fast fourier transform

DTFT and DFT Relationship, Discrete Fourier transform (DFT), Properties of the DFT: periodicity, linearity, and symmetry properties, relationship of the DFT to other transforms, DFT as a linear transformation, multiplication of two DFT and circular convolution, Efficient Computation of the DFT, FFT Algorithms: Radix-2 FFT Algorithms: Decimation in-Time (DIT), Decimation-in-Frequency (DIF)

Practice:

1. MATLAB simulation for DFT & IDFT.
2. DIT and DIF FFT by MATLAB simulation.

Module III: Design And Realization Of Digital Fir Filters

	FIR Filter Structure: Direct Form-I, Direct Form-II, Linear Phase FIR Filter, Liner Phase FIR Filter, Design of FIR Filters Using Windowing Techniques, Design of FIR Filter by Frequency Sampling Technique **Practice:** MATLAB Simulation of FIR filters using windows technique (Rectangular, Hamming and Hanning). 2. MATLAB simulation of LPF and high pass filter by FIR filter. **Module IV: Design And Realization Of Digital Iir Filters** Design of IIR Filters from Analog Filters(Butterworth Approximation): IIR Filter Design by Impulse Invariance, IIR Filter Design By The Bilinear Transformation, Realization of Digital Filter by using Direct Form-I, Direct Form-II, Cascade Form and Parallel Form Structures. **Practice:** 1. Design of IIR Butterworth filter from filter specification (both programming & and by using FDA tool box). 2. Design of IIR low pass Butterworth filter using impulse invariant transformation from filter specification. **Module V: digital image fundamental** Image fundamental, Types of Images, A simple Image Model, Steps of Image Processing, Color Image and Color Models, Sampling and Quantization, Pixel Relationship (Neighbor and Adjacency) **Practice:** Image read and writes operation using MATLAB. 2. Reading an image and display the grayscale, color and B/W image using MATLAB. 3. Reading an RGB Image and extract the color components using MATLAB. **Module VI: digital image enhancement** Spatial Domain Enhancement, Brightness and Contrast Enhancement, , Basic Gray Level Enhancement-Image Negative, Histogram Equalization, Basic Filtering Operation for Smoothing and Sharpening Filter (Use of Filter Kernel), 2D Fourier Transform and Filtering in Frequency Domain, Ideal Low pass and High Pass Filter for Frequency domain Smoothing and Sharpening **Practice:** Brightness and contrast enhancement of an image using MATLAB. 2. Simulation of Image negative using MATLAB. 3. MATLAB Simulation of Image smoothing and sharpening using different mask. **Module VII: digital image restoration** Image Restoration, Model of Image Degradation / Restoration process, Gaussian and Salt and Pepper Noise, Restoration using Mean Filters and Order Statistic Filters (Median and Min-Max Filtering) **Practice:** MATLAB Simulation of Image noising using different noise distribution. 2. MATLAB Simulation of Image De-noising using Arithmetic mean and median filter.

3. MATLAB Simulation of Image De-noising using Order Statistics Filter (Median, Min-Max Filter).

Text Books:

1. V. K. Ingle and J.G. Proaksis, J.G, "Digital Signal Processing-A MATLAB Based Approach", Cengage Learning Publisher
2. S. Salivahanan, A. Vallavaraj and C. Gnanapriya, "Digital Signal Processing", McGraw-Hill Publication
3. Gonzalez, Rafael C., and Richard E. Woods, "Digital Image Processing" 2nd Edition, Pearson Education, 2002.

Reference Books:

1. Tarun K.Rawat, "Digital Signal Processing", Oxford University Press India
2. Sridhar S. Oxford university publication. Digital Image Processing. 2001.
3. Gonzalez, Rafael C., and Richard E. Woods, Steven L Eddins "Digital Image Processing using MATLAB" , Pearson Education, 2009.

Courseware link: http://courseware.cutm.ac.in/courses/digital-signal-image-processing/

2.	**CUTM1062**	**Theory of failure analysis using FPA**	**4 (2+2+0)**

Course Objectives

- To educate the students on basic theories behind mechanics of solids.
- To educate the students on Finite Element Analysis concept applicable to Practical conditions.
- To educate the students on Failure Criterion which will be useful for designing Practical problems.
- To educate the students on using 3D Experience Tools for analysis of various mechanical structures and load transmitting elements.

Course Outcomes

- Students will have knowledge and practical engineering skills in analysis of mechanical strength of structures and load transmission elements and will be able to design them based on input data.
- Students will be able to deploy 3D Experience Platform to develop design solutions.
- Students will be able to apply the Concept of Meshing and Failure Criteria to Practical Problems which will lead Economical and safe in Design Aspect.

Syllabus

Module I: Introduction to Finite Element Analysis (FEA) and 3D Experience Platform -

Introduction to FEA: Need for Studying FEA; Types of Analysis; Discretization of a Structure; Element Shapes, Nodes and Degrees of Freedom; Mesh Refining, Element Aspect Ratio, Use of Symmetry, Principle of Convergence; General Procedure of FEA.

	Material failure Behaviour: Stress–Strain Diagrams for Ductile and Brittle Materials. Equivalent stresses for varying orientations, Principal stresses, maximum shear stress, Mohr's circles. Practice: 1. Introduction to 3D Experience Platform: About the Apps and their Applications from Engineering Point of View. 2. Analysis of Steel Bridge – Simulation using 3D Experience Tool. 3. Tensile Test using Simulation 3D Experience Tool. 4. Stress Strain Curve of a Ductile Material (Mild Steel) using Universal Testing Machine **Module II: Mesh Generation and Modeling of Truss Structure** Mesh Generation and Methods of Meshing and Types of Meshing. Procedure for selecting the method of meshing and type of meshing. Importance and application of Stiffness Matrix for different types of elements and the procedure for getting the results. Practice: 5. 3D Experience Simulia – Modelling and Meshing of Transmission line tower. **Module III: Stresses and Deflection Criteria** Procedure for Drawing Shear Force and Bending Moment Diagrams, Point of Contra Flexure. Stresses (No Derivation): Simple or Pure Bending, Flexure Formula, Section Modulus, Neutral Axis, Determination of Bending Stresses, Shear Stress Distribution for Different Sections. Deflection : Equation of Elastic Curve, Direct Integration Method Practice: 6. 3D Experience Simulia – Modelling and Finite Element Analysis of Framed Structure subjected Earthquake Loads. **Module IV: Theories of Failure** Theories of Failure: Failure Under Biaxial Loading, Rankine's Theory, Guest's or Tresca's Theory, Von Mises Theory, Graphical Representation of Failure, Safety Factors, Prevention of Failure in Design Stage, Diagnosis of Failure In Post-Manufacturing Stage. Practice: 7. 3D Experience Simulia: Bicycle Frame Structural Analysis **Module V: Torsion** Torsion: Torsion Equation, Design of Shafts, Power Transmitted by Shafts, Composite Shafts, Combined Bending and Torsion, Closed-Coiled Helical Springs, Spring Connected in Series and Parallel. Dynamic Analysis: Fundamentals of Vibration; Evaluation of Natural Frequencies and Mode Shapes (Eigen values and Eigenvectors); Non-linear Analysis, Fatigue Analysis. Structures Subjected to Blast Loads. Practice:

	8. Simulation: Static and Dynamic Analysis of Shaft **Module VI: Pressure Vessels** Longitudinal and Hoop Stress in Thin-walled Pressure Vessels Subjected to Internal Pressure. Practice: 9. Simulation: Crack Analysis of Thin walled Pressure Vessels. **Module VII: Fatigue and Fracture** Fatigue: Failure Under Cyclic Loading, Endurance Limit. S-N Curve, Stress Concentration, Goodman and Soderberg Criteria. Fracture: Types of Failure, Brittle and Ductile Fracture, Basic Modes of Fracture. Griffith's Analysis, Crack Growth and Stress Intensity Factor. 10. Fatigue Analysis of Crankshaft of Two-Wheeler **Text Books:** 1. Strength of Materials, S.S. Rattan, Tata Mc-Graw Hill Publication. 2. Advanced Mechanics of Materials, A.P. Boresi and R.J. Schmidt, Willey India Reference Books: 1. Elements of Fracture mechanics, Prashant Kumar, McGraw Hill Education (India) 2. Engineering Mechanics of Solids, Egor P. Popov, Pearson publication 3. Strength of Materials, R.K.Bansal, Laxmi Publications. **Courseware link:** http://courseware.cutm.ac.in/courses/theories-of-failure-using-finite-element-analysis/		
3.	**CUTM1081**	**Computer Aided Engineering**	**3 (0+2+1)**
	Course Outcomes: • Create complete finite element models • Submit and monitor analysis jobs • View and evaluate simulation results **Course Objectives:** • This course will help student to use structural scenario, thermal scenario and to do Structural analysis and Thermal analysis of various problems. **Syllabus:** **Module I: Material and Selection Properties** Property Module, Material Definitions, Linear Elasticity, Large Strain Elasticity, Metal Plasticity, Material Calibration, Material Databases, Section Properties **Practice:** Analysis of crack in pressure vessel Cable stayed bridge simulation		

	Module II: Element Selection Criteria Solid Element Selection, Structural vs. Continuum Elements, Modeling Bending Using Continuum Elements, Stress Concentrations **Practice:** Stress analysis of rail road with wheel. Bike frame structural analysis **Module III: Meshing (8 Hrs)** Mesh Module, Mesh Elements Mesh Generation Workflow, Local Fine-tuning Quality Checks, Mesh Compatibility, Mesh Convergence, Dependent and Independent Part Instances **Practice:** Airplane bracket structural analysis Structural analysis of wind turbine blade **Module IV: Boundary Condition (6 Hrs)** Step Module, Analysis Steps and Procedures, Output Requests, Output Files Load Module, Loads and Boundary Conditions, Initial Conditions **Practice:** Generative structural analysis applied for design optimization Stress analysis on a backhoe **Module V: Contact (6 Hrs)** Mechanical Contact Properties, Contact Domain, Contact Formulation and Controls, Handling Initial Over closures, Contact Output **Practice:** Analysis of Economizer. Analysis of Screw Jack **Module VI: Analysis Procedures (6 Hrs)** Model and Analysis Steps, Analysis Procedures, The static, general analysis procedure, Finding a converged solution, The Static, Linear Perturbation procedure, Buckle procedure, Frequency Procedure, The dynamic, explicit analysis procedure, Stability Limit, Analysis Continuation Techniques **Practice:** Steady state analysis of a composite bar. **Module VII: Thermal Analysis (8 Hrs)** Steady State Heat Transfer, Transient Heat Transfer, Thermal Interfaces, Thermal Stress Analysis **Practice:** Temperature distribution in radiators used in automobiles Oven radiation simulation Steady state thermal analysis of tungsten coil with internal heat generation Thermal analysis of disc brake **Projects** Thermal Analysis of PV Solar Pannel Structural and thermal analysis of Green House Structural analysis of Quadcopter. Structural analysis of landing gear.

	Numerical study on different types of fins. Overhead tank failure analysis. Analysis of Rocket Nozzle Analysis of BAJA SAE Structural and Thermal Analysis of Downdraft Gasifier Structural and Thermal Analysis of Stirling Engine Structural Analysis of Hydraulic Press Structural Analysis of Elevating Conveyor *Text Books/ Reference Books/ Reference Material* SIMULIA: 3DS Learning Space **Courseware link: http://courseware.cutm.ac.in/courses/12824/**		
4.	**CUTM1091**	**Theory of Machine**	**(2+1+0)**
	Course Outcomes: • Identify mechanisms in real life applications. • Perform velocity and acceleration diagrams for various mechanisms. • Able to know various power transmission systems • To know the importance of Gyroscope, cams and Governors • To perform static and dynamic balance of simple mechanisms • To have understanding about the effect of vibration and vibration control **Course Objectives:** • To make the student conversant with commonly used mechanisms in various machines • To develop skills for drawing velocity and acceleration diagram for linkages, cams, gears and other mechanisms • To address the underlying concepts, methods and application of different machines. • To understand the concepts of speed control mechanisms • To understand the concepts of Vibration **Syllabus:** **Module I: MECHANISMS** **Theory** Planar Mechanisms: Kinematic Link, Pair, Chain and Mechanism, Types of Links and Joints, Degree of Freedom, Grashof's Law for four bar Mechanism; Inversions of four bar Mechanism, Single Slider Crank Mechanism and Double Slider Crank Mechanism; **Practice** (01 hrs) 1. Position Analysis of Grashof and Non-Grashof four bar Mechanism. 2. Position Analysis of Slider Crank Mechanism, Scotch Yoke Mechanism and Elliptical Trammel **Module II: MOTION ANALYSIS** **Theory** Instantaneous Centre of Rotation, Number and Types of Instantaneous Centers, Kennedy Theorem, Relative Velocity Method, Velocities and acceleration in Four Bar and Slider Crank Mechanism. **Practice** 3. Instantaneous Center Method to Find Velocity of Various Mechanisms. 4. Velocity Analysis of Grashof and Non-Grashof Four Bar Mechanism 5. Velocity Analysis of Slider Crank Mechanism.		

	6. Acceleration Analysis of Slider Crank Mechanism **Module III: Power Transmission Systems** **Theory** Classification and Basic Terminology, Fundamental Law of Gearing, Gear trains: Simple, Compound, Reverted and Epi-Cyclic Gear Trains Flat Belt, V Belt and Rope Drives and chain drives ,Length of open and cross belt drive, Power Transmitted by Belts and Ropes. **Practice** 7.Length of open and cross belt drive **Module IV: CAMS& GOVERNORS (03hrs)** **Theory** Various Types of Cams and Followers; Displacement, Velocity and Acceleration Diagrams for Different Follower Motions; Nomenclature of Cam Profile; Classification of Governors, working principle of various type of centrifugal governors, Terminology related to Governor. **Practice** 8. Construction of cam profile using Solid works software 9. Cam analysis of a Knife edge and roller follower 10.To calculate sensitiveness of Governor **Module V: GYROSCOPE** **Theory** Gyroscopic Couple, Gyroscopic Effect on Naval Ships and Aeroplanes, Stability of four wheeler **Practice** 11. Determine Gyroscopic Couple on Motorized Gyroscope **Module VI: BALANCING** **Theory** Static and Dynamic Balancing, Balancing of Several Masses Revolving in the Same Plane and Different Planes, Balancing of Reciprocating Mass **Practice** (02 hrs) 12. Balancing of Several Masses Revolving in the Same and Different Planes 13. Balancing of Reciprocating masses by Simulation **Module VII: VIBRATION** **Theory** Basic Concepts and Types of Vibration, Methods of Vibration Analysis, Free Undamped Longitudinal, Transverse and Torsional Vibrations, Damped Free Vibrations, Logarithmic Decrement, Vibration Isolation and Transmissibility; **Practice** 14. Determination of Critical or Whirling Speed of Shaft 15. Simple and Compound Pendulum Courseware link:		
5.		**Heat Transfer with FVM**	**3(2+1+0)**
	Course Objectives • To provide a good exposure for the students to various phenomena associated with fluid flow and different modes of heat & mass transfer **Course Outcomes** • Students will be able to analyze and design various Equipment used in industry using principles of Heat Transfer **Syllabus:**		

	Module I: Conduction Fourier's Law of Conduction, General Heat Conduction Equation in Different Coordinate Systems (No Derivation), One Dimensional Steady State Conduction in Plane Wall, Composite Wall, One Dimensional Steady State Conduction in Composite Cylinders and Composite Spheres with Convective Atmosphere. Electrical Analogy, Conduction with Internal Heat Generation. **Practice** 1. To find the thermal conductivity of a material by the two slabs guarded hot plate method. 2. To find heat transfer through composite wall using Simulia **Module II: Fins and Transient Conduction** Overall Heat Transfer Coefficients, Critical Thickness of Insulation, Heat Transfer from Extended Surfaces, Effectiveness and Efficiency, Unsteady State Heat Conduction, Lumped Heat Capacity System and Lumped Capacitance Method. Practice 3. To find the thermal resistance of the sample. 4. To find the thermal resistance of the sample using Simulia 5. To find the heat transfer in Transient Heat Conduction using Simulia 6. Module III: Convection (9 Hrs) Hydrodynamic and Thermal Boundary Layer, Principles and Governing Equations, Forced Convection: External Flow over a Flat Plate, Cylinder, Sphere and Non-Circular Ducts, Use of Empirical Relations, Internal Flow Through Pipe, Annular Spaces and Non-Circular Conduits, Natural Convection: Vertical, Horizontal, Inclined Surfaces. **Practice** 7. To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method. 8. To verify Newton's Law of Cooling of different materials and different liquids. 9 .To determine heat transfer coefficient using Simulia 10. To find the temperature variation and heat transfer along cylinder in forced convection using Simulia 11.To find the temperature variation and heat transfer along solid cylinder in natural convection using Simulia **Module IV: Heat Transfer With Phase Change** Film Wise and Drop Wise Condensation, Boiling Heat Transfer, Regimes of Boiling. **Module V: Heat Exchangers** Types of Heat Exchangers, Heat Exchanger Analysis Types of Heat Exchangers, Heat Exchanger Analysis, LMTD, Overall Heat Transfer Coefficient, Heat Exchanger Effectiveness, NTU.

Practice
Determination of Effectiveness and Efficiency of Parallel Flow and Counter Flow Heat Exchanger.
CFD simulation of Heat Exchanger using Simulia
Module VI: Radiation (8 Hrs)

Electromagnetic Spectrum, Black Body Emission, Emissive Power, Laws of Radiation, Nature of Black and Grey Bodies, Concepts, Radiation Shape Factor, Thermal Resistance and Electrical Analogy, Radiation Heat Transfer Between Two Surfaces, Reradiating Surface, Radiation Shield.

Practice

To find the emissivity of different material surface. Verification of Stefan Boltzmann's Law using simulia Module VII: Mass Transfer (4 Hrs)

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

Text Books:

1. Mahesh M. Rathore, Engineering Heat Transfer , Jones & Bartlett Learning, 2011
2. 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

Courseware link: http://courseware.cutm.ac.in/courses/heat-transfer-2/

6.	**CUTM1089**	**Fluid Mechanics with FVM**	**3(2+1+0)**

Course Outcome:
- After completion of the course, the students will able to evaluate finite difference/volume schemes on model problems of computational fluid dynamics.
- Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems

Course Objectives:
- To learn fundamentals of computational methods like FVM for solving linear and non-linear partial differential equations related to fluid dynamics
- To emphasizes the basic underlying fluid mechanical principles governing energy transfer in a fluid flow system with their performances in different field of engineering applications.

Syllabus:
Module I: Introduction to Finite volume Method
Fundamentals of Finite volume methods, different types of finite volume grids, approximation of surface and volume integrals; interpolation methods, Review of governing equations, Classification of governing equations , Staggered and co-

	located formulation Practice 1- 2D mapped Mesh for rectangular pipe Practice 2- 2D mapped Meshing for Aerofoil. **Module II: Grid generation** Grid generation, creating, updating and managing meshes, Steady diffusion equation on structured meshes, Unsteady diffusion equation on structured meshes, Linear system solvers, , finite volume discretization of steady and unsteady diffusion equation, Finite volume discretization of convection-diffusion problem Practice 3- 3D structure mesh of Circular Cylinder Practice 4- 3D unstructured mesh with primes layers for Aerofoil Practice 5- 3D coarse/ medium/ fine sweep mesh for pipe **Module III: Incompressible flow field calculation with finite volume method** Navier-stokes equation, Discretization of the Momentum Equation: Stream Function-Vorticity approach and Primitive variable approach, Staggered grid and Collocated grid solutions of Navier-stokes equation with finite volume method, boundary condition, Reynolds averaged Navier-Stokes equations. **Module IV: Fluid kinematics** Types of flow, Continuity equation (in one, two& three dimension steady state fluid flow analysis with finite volume method, velocity and acceleration fields, streamline, streak line, path line, velocity potential function and stream function, Rotation and vorticity. **Module V: Fluid Dynamics with Finite volume method** Lagrangian and Eulerian Approach, Euler's equation of motion along a stream line for ideal flow, Principle of conservation of energy with finite volume method, Integration of Euler's equation along a stream line, Bernoulli's equation Practice- 6. Fluid Analysis of Bernoulli's equation: Flow in a contracting pipe through CFD simulation **Module VI: Flow through Pipes** Reynolds's Experiment, Laws of Laminar and Turbulent Friction, Introduction Turbulence modeling through Finite volume method, Hagen Poiseulle Equation for laminar flow through pipe, Darcy-Weisbach Equation for Turbulent flow through pipe. Practice-7. Fluid Analysis of Laminar flow in 3D Circular Pipe through simulia software Practice-8. CFD Simulation of the Water Flow Passing Through a Converging Pipe. Practice-9. CFD Analysis to determine the frictional losses in the pipe. **Module VII: Flow Measurement** Flow through small orifice meter, Mouthpiece, Velocity Measurement using Pitot tube, Prandtl tube, Flow measurement in pipes-Flow, Venturi Meter, Flow rate Measurement in channel- Weir and Notches Practice-10.CFD Analysis of Fluid flow through Orifice meter Practice-11.CFD Analysis of Fluid flow through adjustable channel Practice-12.CFD Analysis of Fluid flow simulation through Venturi Meter **Text Books:** 1.R.K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, ninth edition. **Reference Books:** 1.P.N. Modi & S.N. Seth, Hydraulics & Fluid Mechanics, Rajsons Publications Pvt. Ltd, Twentieth Edition Courseware link: http://courseware.cutm.ac.in/courses/fluid-mechanics-hydraulic-machinery/	
7.	**CUTM1090**	**Hydraulic machinery**	**2(1+1+0)**

	Course Outcome: After completion of the course, the students will have a strong foundation on the pertinent equations to engineering design of the machines for required applications. Students will learn to determine performance characteristics of fluid machinery by using various simulation tools **Course Objectives:** To emphasizes Principle of operation of hydraulic machines and their system design To familiarize their huge applications in different industries **Syllabus:** **Module I: Principle of Operation of Hydraulic Machinery** Introduction to hydraulic machines: Classification and operation principle, Euler equation for turbo machines: net head developed by pump and Turbines **Module II: Radial and Axial flow pumps** Velocity triangle of pumps, effect of inlet swirl on velocity triangles, Constructional features of Centrifugal Pump, design aspect, working principle and efficiencies, work done by the impeller, priming, specific speed, NPSH, effect of swirl on the cavitation, working principle and design aspect of gear oil pump. **Practice:** 1.Flow analysis of fluid of Centrifugal pump through Simulia software 2.Flow analysis of gear oil pump through Simulia software 3.Performance Characteristics of Centrifugal Pump through Virtual lab **Module III: Positive displacement Pumps** Working principle of Reciprocating Pump, discharge, works done and power requirement, ideal indicator diagram, and slip, characteristic H-Q curve of positive displacement pump **Practice:** 4.Performance Characteristics of Double Acting Reciprocating Pump through Virtual lab. **Module IV: Hydraulic Turbine: Impulse Turbine** Classification, definitions of heads and efficiencies, Pelton Wheel – Construction and working principle, work done and hydraulic efficiency, design aspects. **Practice:** 5.Simulation of Pelton Turbine through simulia software 6.Performance Characteristics of Pelton Turbine through Virtual lab. **Module V: Hydraulic Turbine: Reaction Turbine** Reaction turbine (Francis, Kaplan) -Components, working principle, work done and efficiency, draft tube, specific speed, cavitation **Practice:** 7. Performance Characteristics of Francis Turbine Simulia software. 8. Simulation of Kaplan turbine through through Virtual lab. Courseware link: http://courseware.cutm.ac.in/courses/hydraulic-machinery/		
8.	**CUTM1088**	**Thermodynamics**	**3(2+1+0)**
	Course Outcome: • 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 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

Syllabus:

Module I: Basic Concepts of Thermodynamics4

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

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

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 Thermodynamics

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

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: Entropy

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 Courseware link: http://courseware.cutm.ac.in/courses/thermodynamics-2/		
9.	**CUTM1054**	**Electrical Machines Operation and Control**	**3 (3+1+0)**
	Course Objectives • To introduce the students about principles of electromagnetism applied to alternating machines. • To familiarise the students about the fundamental laws that governs the operation of machines and to extend its application to synchronous generator and motors. • To introduce the students about the constraints associated with starting of Induction motors. • To develop selection skill to identify the type of generators or motors required for particular application. **Course Outcomes** On completing this course, students will be able to: • Distinguish the constructional similarity and dissimilarity between various machines. • Perform different tests on various machines. • Understand electromagnetic and electromagnetic induction. • Understand DC Machines. • Understand single and three phase A.C circuits, and Understand AC machines. **Syllabus** **Module-I: D.C. Machines** **Theory:** Construction, Classification and Principle of operation of DC machines. Theory & testing:-EMF equation of DC generator, DC Motor Characteristics, Speed Equation of DC Motor. Characteristic for Speed Armature Current, Torque Armature Current and Speed Torque of (i) Separately Excited DC Motor, (ii) DC Shunt Motor, (iii) DC Series Motor, and (iv) DC Compound Motor, Comparison between Different types of DC Motors Application- DC Generator, DC Motor-Types. **Practice:** 1) Determination of OCC (Open Circuit Characteristics) of D.C Shunt Generator.		

2) Starting & Speed Control of D.C Shunt motor by (i) Field flux control method & (ii) armature voltage control method.
3) Starting & Speed Control of D.C Series motor by (i) Field flux control method & (ii) armature voltage control method.

MODULE II: Stepper Motors (Precision Machines)

Theory:
Stepper motor drive, basic principles involved in stepper motor control, stepper motor specification, operation and commercial driver chips and packages, Brushless DC Motors, Reluctance Motor, Hysteresis Motor Application in Medical, Automobile, Civil, Electrical etc
Practice:
4) Motor Voltage and Current Measurement.
5) ON-Load Tap changer

Module-III: Induction Motors

Theory:
Principles of operation of induction motors, both single and 3-phase types. Torque-speed curves, Different types of single phase motors Three Phase Induction Motor. Equivalent Circuit and Phasor Diagram, No-Load and Blocked Rotor tests, Determination of Parameters, Slip-Torque Characteristics Losses and Efficiency, Effect of rotor resistance, Starting and speed control methods, Cogging, Crawling and Electrical Braking of Induction Motors. Applications of three & single phase motors which will assist in picking the right one for an application.
Practice:
5) Determination of parameter of a single phase induction motor and study of (a) Capacitor start induction motor (b) Capacitor start and capacitor run induction motor
6) Determination of Efficiency, Plotting of Torque-Slip Characteristics of Three Phase Induction motor by Brake Test.
7) Load test of a 3 phase slip ring induction motor.

Module-IV: Three Phase Synchronous Generators

Theory:
Construction, Principle, Coil Pitch, Distributed Windings in A.C. Machines, The Equivalent Circuit of a Synchronous Generator (Armature Reaction Reactance, Synchronous Reactance and Impedance). The Phasor Diagram of a Synchronous Generator, Power and Torque in Synchronous Generators (Power Angle Equation and Power Angle Characteristic)
Practice:
8) Plotting the open circuit and short circuit characteristics of alternator.
9) Calculating the voltage regulation by synchronous impedance method.
10) Calculating the voltage regulation by zero power factor method.

Module-V: Parallel Operation Of Three Phase AC Synchronous Generators
Theory:

	Synchronous condenser, Hunting, Paralleling-Conditions, Procedure, Operation of Generators in Parallel with Infinite bus bar, Effect of excitation, effect of unequal voltage and steam power supply. **Practice:** 11) Connection & verifying the conditions of parallel operation of alternators. 12) Verification of direct axis reactance, quadrature axis reactance 13) Load Sharing during parallel operation using Dymola. **Module-VI: Three Phase Synchronous Motors** **Theory** Basic Principles of Motor operation, Construction, Starting Synchronous Motors, Synchronous Motor Ratings, Equivalent circuit & phasor diagram, Effect of excitation on varying load, power developed in a synchronous motor. Applications of synchronous motors **Practice:** 14) Study of universal motor and shaded pole motor. 15) Use of synchronous motor as a synchronous condenser for p.f improvement. **Module-VII: Single-Phase Transformers** **Theory:** Construction and principle of operation, EMF Equation, Transformation ratio, Practical and Ideal transformers Three Phase Transformers: Three-phase transformer connections- Star-star, Two Single-Phase Transformers connected in Open Delta (V-Connection) and their rating, Delta-star, Zig-zag connections. Scott connection, Open delta connection. Auto Transformers, Welding Transformer. Application of Single & Three Phase transformer Practice: 16) Prescribed tests of single phase and three phase Transformer. 17) Load balancing in a three phase distribution Transformer. 18) Simulation of open delta condition of Transformer. TEXT BOOK: Electrical Machines – D P Kothari and I J Nagrath, Fourth Edition – Tata McGraw Hill. REFERENCE BOOKS: Electrical Machinery – P S Bimbhra – Khanna Publishers. Electrical Machines - P. K. Mukherjee, S. Chakravarti, Dhanpat Rai & Sons **Course ware link:** http://courseware.cutm.ac.in/courses/electrical-machines-operation-and-control/	
10.	**CUTM1057**	**Basic Electrical Engineering**	**2 (1+1+0)**
	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.

Syllabus:

Module I: Basic Concepts and Basic Laws

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

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

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

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

Practice (Hardware):

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

Module VI: AC Circuit Analysis

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 Courseware link: http://courseware.cutm.ac.in/courses/basic-electrical-engineering/
11	**CUTM1073** **Geotechnical Engineering** **3(1+1+1)**
	Course Outcome: • To obtain knowledge about soil properties and methods of soil properties determination in the laboratory, using field tests and considering comparable experience. Basic stability and deformation problems. Principle of spread and deep foundation design. To understand fundamental knowledge of geotechnical works for soil improvement, interaction of structure and subsoil. Basic design methods for excavation and foundation pits with dewatering and sealing systems. • Design and analyse Shallow foundations manually as well as using STAAD Pro • Design and analyse Deep foundations manually as well as using STAAD Pro • Carry out Moisture content, Specific gravity, Atterberg limits tests. • Carry out Grain size distribution, Proctor tests. • Carry out Unconfined compression, Triaxial tests. • Carry out California Bearing Ratio, Vane Shear tests • Carry out Sand replacement, Core cutter, Permeability tests. **Course Objectives:** • Perform Moisture content, Specific gravity, Atterberg limits tests • Perform Grain size distribution, Proctor tests. • Perform unconfined compression, Triaxial tests. • Perform California Bearing Ratio, Vane Shear tests. • Perform Sand replacement, Core cutter, Permeability tests. **Syllabus:** **Module I:** Theory (a) INTRODUCTION: Soil formation - soil structure and clay mineralogy - Adsorbed water - Mass- volume relationship - Relative density.

	(b) INDEX PROPERTIES OF SOILS: Grain size analysis - Sieve and Hydrometer methods - Consistency Limits and Indices - I.S. Classification of soils (c) PERMEABILITY: Soil water - capillary rise - flow of water through soils - Darcy's law- permeability - Factors affecting - Determination of coefficient of permeability - Permeability of layered systems (d) SEEPAGE THROUGH SOILS: Total, neutral and effective stresses - quick sand condition - Seepage through soils - Flow nets: Characteristics and Uses (Basic appraisal only). **Practice:** 1. Determination of water content of soil 2. Determination of specific gravity of soil 3. Grain size analysis by sieving (Dry sieve analysis) **Module II:** **Theory** (e) COMPACTION: Mechanism of compaction - factors affecting - effects of compaction on soil properties. Field compaction Equipment - compaction control. (f) CONSOLIDATION: Stress history of clay; e-p and e-log p curves - magnitude and rate of 1-D consolidation- Terzaghi's Theory. **Practice** 4. Determination of field density by sand replacement method. (1hrs) 5.Determination of consolidation properties of soils.(1:15mins) 6. Determination of unconfined compressive strength of soil(1:15mins) **Module III** **Theory** (g) SHEAR STRENGTH OF SOILS: Mohr - Coulomb Failure theories (h) STRESS DISTRIBUTION IN SOILS: Normal and shear stresses on a plane, Boussinesq's solution. **Practice** 7. Determination of shrinkage limit; Determination of permeability by constant head method **Project** • Types of shear strength test to be delivered as project mode, rest of the topics to be dealt in classroom teaching mode, Mathematical Derivations to be limited to classroom activity. They should not be a part of External Evaluation. **Module IV:** **Theory** (i) DESIGN OF SHALLOW FOUNDATIONS: Introduction, Different types of shallow foundations, (j) DESIGN OF DEEP FOUNDATIONS: Introduction, Different types of deep foundations, Design methodology for piles. **Practice:** 8. California bearing ratio test (1hrs) **Project :** • Design calculation of shallow foundation to be done in project mode using STAAD Pro software. • design calculation of pile capacity, Analysis of pile group, Settlement of pile group, Concept of negative skin friction, Piles subjected to lateral loads, Pile load test, Design and construction of well foundation. Design of cantilever sheet piles and anchor sheet piles to be done in practice mode as well as project mode using STAAD Pro software. **Module V:**

Theory:(2hrs)
(k) FOUNDATIONS IN DIFFICULT GROUNDS: Introduction, Techniques of ground improvement, Foundations in swelling soil, Foundations in collapsible soil, Use of soil reinforcement.
(l) MACHINE FOUNDATIONS: Introduction, Free and forced vibration, Lysmer's method, dynamically loaded foundations, Dynamic soil properties, Vibration isolation. BASIC APPRAISAL ONLY.NO NUMERICAL PROBLEMS)
Practice:
9. Determination of shear parameters by Direct shear test
10. Determination of compaction properties by standard proctor test.
Module VI:
Practice:
11. Determination of shear parameters by Tri-axial test.
Project:
• STABILITY OF SLOPES: soil stabilization measures. Slope stability solutions to done using software Stability analysis of rigid walls, (MATLAB)
Module VII
(0) EARTH PRESSURE: Types of Earth pressure. Rankine's Active and passive earth pressure, Smooth Vertical wall with horizontal backfill. Extension to Soil, Coulombs wedge theory.
(p) DESIGN OF RETAINING STRUCTURES: Introduction, Different types of retaining structures
E Books: Jain A K and Jain A K. 2005. Soil Mechanics and Foundations. Laxmi Publications (P) Ltd. New Delhi.
Ranjan Gopal and Rao A S R. 1993. Basic and Applied Soil Mechanics. Welley Easters Ltd., New Delhi.
Singh Alam. 1994. Soil Engineering Vol. I. CBS Publishers and Distributions, Delhi.

Courseware link: http://courseware.cutm.ac.in/courses/geotechnical-engineering/

12	**CUTM1074**	**Design of structures**	**4(1+3+0)**

Course Outcome:
- To gain the knowledge of RCC design calculation with relevant Indian Standards.
- After completion of the courses the students will gain knowledge of Pre-Engineered design calculation with relevant Indian Standards
- Students will develop skill of converting client's requirement to structural drawing by using ETABS.

Course Objectives:
- To teach the basic theoretical aspects and contemporary issues in the design and fabrication of reinforced concrete members
- To teach the basic fundamental behavior of different section, bolts, members of steel structure used in construction
- To analyze and Design of Concrete Structures and Pre-Engineered Building(PEB) by using Software ETABS

Syllabus:
Module I: Building Structural Frame (9 Hours):

	Introduction to Reinforced Concrete, Mechanical Properties of Concrete, Flexural Analysis, Combined Flexure and Axial Load, Shear analysis. Limit State Method using Indian Standard Codes. **Practice:** 1. Draw grids, Reference planes and joints, create new project models and introduction of the layout. (2hr) 2. Draw building structural frame and define material properties (4hrs) **Module II: Load definition to Building frame (5 Hours):** Modeling of Building, Load Calculations, Seismic weight, Base shear, Storey shear, Mass source, diaphragm, Meshing of Slab. **Practice:** • Building structural frame- Define Properties, Material, Section, Mass source, Load pattern, load combinations • Define Section Properties + Section Property Modifiers (1hr) • Load Pattern (Gravity Loads + Earthquake (seismic) Loads (0.5hr) • Wind Loads, Dead loads, super dead loads and live loads introductory(0.5hr) • Define Load combination (Manual + Auto)(0.5hr) • Meshing for Slabs, Walls, beams and Columns (0.5 hr) • Assign Loads to structure as per IS Codes(0.5) • Define Mass Source (For Lateral analysis)(0.5 hr) • Pier Labels and Spandrel Labels for shell members such as shear walls and retaining RCC walls (1hr) **Module III: Analysis and check for Safety (10 Hours):** Analysis checks, Post design checks, Pushover analysis, response spectrum analysis, time history analysis. **Practice:** • P Delta Analysis Check (How to include P-delta effects) (2hr) • Center of Mass and Center of Rigidity (and Building Eccentricity Check) • Mass (Weight) Irregularity check as per the code (1hr) • Story Displacement, Story Drift checks as per code (1hr) • Torsional Irregularity check • Modal Analysis Case [Eigen or Ritz Vectors], Time period (1hr) • Time History Analysis (2hrs) **Module IV: Reinforcement Detailing and scheduling (6 Hours):** ● Reference of IS codes IS SP 34-1987 (Theory) (1hr) ● IS 13920-1993 Ductile Detailing of RC structures (Theory) (1 hr) **Practice:** 11. Detailing of Beams, Columns and slabs using Autocad (4hr) **Module V: Design of Foundations using SAFE foundation (6 Hours):** Introduction to SAFE foundation, familiarizing tools used in SAFE foundation. Types of foundations introduction, isolated footing design, combined footing design and mat foundation design. **Practice:** 12. Importing ETABS model file into the SAFE foundation software (0.5 hr) 13. design of isolated footing (1 hr) 14. design of combined footing (1 hr) 15. design of mat foundation (1 hr) **Module VI: Materials and Specifications of Steel/ Pre-Engineered Building (PEB) Structures (06 Hours):** PRE-ENGINEERED BUILDING COMPONENTS: Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts

	– Bracing System: Rod, angle, Portal, Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases. **Practice:** 16. DESIGN LOADS ON PRE-ENGINEERED BUILDINGS. Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code IS:800. (4hrs) **Module VII: PEB DESIGN METHODOLOGY (8 Hours):** **Practice:** 17. Design Parameters of PEB Frames - Depth of the section, Depth to Flange width ratios, Thickness of Flange to thickness of Web ratio. d/tw, bf/tf ratios of sections as per IS code. Section Sizes as per Manufacturing Limitations. Analysis and Design of Rigid Frames. Rigid Frame Moment Connection, Shear Connection- Anchor bolt and base plate design (Pinned and Fixed). (8hrs) **Text Books:** 1. Reinforced Concrete design-S. N. Sinha. Tata McGraw-Hill, New Delhi 2. S K Duggal," Design of steel structures", 2012. 3. S. Ramamurtham and R. Narayan," Design of steel structures" ,2014 Reference: 1. PEB design using ETABS 2. Etabs Full - Video **Courseware link:** http://courseware.cutm.ac.in/courses/design-of-structures/		
13	**CUTM1063**	**Quantity Estimation and Costing**	**3(2+1+0)**
	Course Outcome: • Students will be able to • Estimating, brick calculations & cost for different materials, foundation & footing calculations. • Gain knowledge about how to schedule & estimate different construction works both manually and using software. **Course objectives:** • To make familiar with calculation of quantities for different item of works &provide knowledge about estimation of buildings through Estimator-2.0 software. • On completion of this course the students will be able to know the process of making animation of buildings, Sketch up of building plan and building models. **Syllabus:** **Module - 1: BUILDING** Reading of Plans, Sections and detailed Drawings Related to buildings; preparation of Quantities and Units. Introduction of estimating & different types of estimate - Requirements for building estimate purpose of estimate - Plinth area estimate, cube rate estimate, annual estimate & maintenance estimate - Brick calculation & cost for different material - No. of brick required for area, weight of bricks, different bricks densities. Practice Sessions: 1. Study of construction drawings and preparation of WBS. (01 Hr) 2. Detailed estimates for a Shopping Complex using Estimator-2.0 software. (01 Hr)		

	3. Detailed estimates for a hostel Building using Estimator-2.0 software. (01 Hr) 4. Detailed estimates for a hospital using Estimator-2.0 software. (01 Hr) **Module -2 : CULVERT** Estimations and Quantity Surveying: Reading of Plans, Sections and detailed Drawings Related to irrigation structures; preparation of Quantities and Units. 1. Detailed estimates (Manual) for a Slab culvert with right angled/ Splayed wing wall. (01 Hr) 2. Detailed estimates (Manual) for a box culvert. (01 Hr) 3. Detailed estimates (Manual) for a Hume pipe Culvert. (01 Hr) **Module –3: ROAD** Estimations and Quantity Surveying: Reading of Plans, Sections and detailed Drawings Related to Roads structures; preparation of Quantities and Units. 1. Detailed estimates (Manual) for a road. (01 Hr) **Module - 4: SLOPED ROOF** Estimations and Quantity Surveying: Reading of Plans, Sections and detailed Drawings Related to Sloping roof/Roof truss structures; preparation of Quantities and Units. 1. Detailed estimate (Manual) for a timber roof truss. (01 Hr) 2. Detailed estimate (Manual) for a roof covers of GI sheets. (01 Hr) **Module –5: QUANTITY SURVEY** Estimations and Quantity Surveying; Preparation of Quantity of materials per unit rate of work; Estimating labor. 1. Quantity of materials required for different items of works in buildings (Manual). 2. Quantity of different types of labor required for different items of works (Manual). **Module-6: RATE ANALYSIS OF BUILDING** Specifications; Rate Analysis as per State Govt. and CPWD Standards. 1. Development of Excel Sheet for Rates, Specifications and Cost Estimates. 2. Rate Analysis and Cost Estimates for a Shopping Complex using Estimator-2.0 software. 3. Rate Analysis and Cost Estimates for a hostel Building and a hospital. (01 Hr) **Module-7: RATE ANALYSIS OF CULVERT & ROAD** Specifications; Rate Analysis as per State Govt. and CPWD Standards 1. Rate Analysis and Cost Estimates for a Slab culvert with right angled wing wall using Estimator-2.0 software. (01 Hr) 2. Rate Analysis and Cost Estimates for an arch culvert. 3. Rate Analysis and Cost Estimates for a road. (01 Hr) **MODULE 8 – PROJECT PREPARATION** 1. Road section C & L-section. (01 Hr) 2. Report of detailed estimation with hard copy. (01 Hr) **Courseware link:** http://courseware.cutm.ac.in/courses/quantity-estimation-costing/	
14	**CUTM1289**	**Fundamentals of Soil Science**	**3(2+1+0)**
	Course Outcome: • Understand the fundamentals and principles of Soil Science • Explain how different soils are formed and how does soils act as a medium for plant growth. • Explain soils of India and Land use capability, soil pollution and its effect on crop and mitigation of soil pollution		

- Analyze the soils for basic physical, physico-chemical &chemical properties.

Course Objectives:

- To impart knowledge to the students on the Fundamentals of Soil Science and impart skills in collecting and analyzing soils for basic physical, physico-chemical and chemical properties for using it as a medium for plant growth.

Syllabus:

MODULE I:

Soil as a natural body, Pedological and edaphological concepts of soil. Components of soil. Soil genesis: Composition of Earth's crust- soil forming rocks and minerals – Primary and secondary minerals. Weathering of rocks and minerals. Factors of soil formation. Soil forming processes. Soil Profile.

MODULE II:

Soil physical properties: Soil texture, structure, density and porosity, soil colour, consistence and plasticity. Soil water retention, movement and availability. Soil air, composition, gaseous exchange-problem and its effect on crop growth. Source, amount and flow of heat in soil, Soil temperature and crop growth.

MODULE III:

Soil physico chemical and chemical properties: Soil reaction-pH, soil acidity and alkalinity, buffering, effect of pH on nutrient availability. Electrical conductivity. Soil colloids - inorganic and organic. Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation.

MODULE IV:

Soil organic matter: composition, properties and its influence on soil properties. Humic substances - nature and properties. Soil Biology: Soil organisms: macro and microorganisms, their beneficial and harmful effects. Soil enzymes.

MODULE V:

Elementary knowledge of soil taxonomy, classification and soils of India - Soil pollution – Types and behaviour of pesticides. Inorganic contaminants. Prevention and mitigation of soil pollution.

PRACTICAL SCHEDULE: EX No.1-11

Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Study of soil forming rocks and minerals. Determination of soil density, moisture content and porosity. Determination of soil colour. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil. Demonstration of heat transfer in soil. Preparation and standardization of laboratory reagents, indicators and buffers. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Estimation of organic matter content of soil. Study of soil map.

References:

1. Indian Society of Soil Science. 2012. Fundamentals of Soil Science, IARI, New Delhi.

2. Das, D. K .2015. Introductory Soil Science, 4 th Edition, Kalyani Publishers, New Delhi

3. Sehgal, J. 2015. A Text Book of Pedology – Concepts and Applications, Kalyani publishers, New Delhi.

Courseware link: http://courseware.cutm.ac.in/courses/fundamentals-of-soil-science/

15	**CUTM1290**	**Fundamentals of Horticulture**	**2(1+1+0)_**

Course Outcome:

- To enable the students to apply various horticultural skills and knowledge in their career.
- To identify and prescribe sustainable options in horticulture which benefit the environment while maintaining productivity and economic viability.

Course Objectives:

- To provide knowledge of horticulture in a brief and prescribed manner.
- To introduce the students to green industry.
- To encourage students to be responsible for environment by demonstrating and valuing sustainable practices.

Syllabus:

Theory:

Horticulture-its definition and branches, importance and Scope; Horticultural and Botanical Classification; Climate and Soil for Horticulture Crops; Plant Propagation Methods and Propagating structures; Principles of Orchard establishment; Principles and methods of Training and Pruning; Juvenility and Flower bud differentiation; Unfruitfulness; Pollination, pollinisers and pollinators; Fertilisation and Parthenocarpy; Kitchen gardening; Garden types and parts; Lawn making; Medicinal and aromatic plants; Spices and condiments; Use of plant bio-regulators in horticulture; Irrigation and Fertilisers application.

Practical:

Identification of garden tools; Identification of horticultural crops; Preparation of seedbed/nursery bed; Practice of sexual and asexual method of propagation; Layout and planting of orchard plants; Training and pruning of fruit trees; Transplanting and care of vegetable seedlings; Making of herbaceous and shrubbery borders; Preparation of potting mixture; potting and repotting; Fertiliser application in different crops; Visit to commercial nurseries and orchards.

References:

1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N.Kumar

Courseware link: http://courseware.cutm.ac.in/courses/fundamentals-of-horticulture/

16	**CUTM1287**	**Fundamentals of Agronomy**	**3(+2+1+0)**

Course Outcome:

- Students will understand the basic concepts of agronomy
- Students will be able to do basic agronomic operations like sowing, fertilizer application, irrigation etc.
- Students will be able to schedule agronomic practices in a crop
- Students will be able to identify seeds, crops, fertilizers and weeds.

Course Objectives:

- To understand the basic concepts and components of Agronomy
- To Understand various agronomic terms
- To have hands on experience of the basic agronomic practices

Syllabus:

Theory:

Agronomy and its scope, seeds and sowing, tillage and tilth, crop density and geometry, Crop nutrition, manures and fertilizers, nutrient use efficiency, water resources, crop water requirement, water use efficiency, irrigation- scheduling criteria and methods; logging; Weeds and its importance, crop-weed competition, concepts of weed management – principles and methods, herbicides- classifications

	and selectivity; Growth and development of crops, factors affecting growth and development, plant ideotypes, crop rotation and its principles, adaptation and distribution of crops, crop management technologies in problematic areas, harvesting and threshing of crops; **Practical** Identification of crops, seeds, fertilizers, pesticides and tillage implements, study of agro-climatic zones of India (including map pointing), Identification of major weeds in crops; methods of herbicide and fertilizer application; study of yield contributing characters and yield estimation, seed germination and viability test, numerical exercises on fertilizer requirement, plant population, herbicides and water requirement, Use of tillage implements-reversible plough, one way plough, harrow, leveler, seed drill and visit for on-farm and on-station field crops; **References** 1. Reddy, S.R. 2016. Principles of Agronomy. Kalyani Publishers, Ludhiana, 5th Edition. 2. Yellamanda Reddy, T. and SankaraReddi, G.H. 2016. Principles of Agronomy, Kalyani Publishers, Ludhiana. 3. Gopal Chandra De. 1989. Fundamentals of Agronomy. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. **Courseware link:** http://courseware.cutm.ac.in/courses/fundamentals-of-agronomy/

BASKET-IV. B

(Core Agricultural Engineering Courses)

(Total Credits: 44)

1	CUTM 2066	Post-Harvest Engineering of Cereals, Pulses and Oil Seeds	3 (2+1+0)

Course objective:

- To impart knowledge on various process technologies for cereals, pulses, oilseeds and their handling and conveying equipment's.

Course outline:

- Know the different unit operations in processing of major cereals, pulses and oilseeds.
- Understand the working principles and selection procedure of different machineries used for processing of cereals, pulses and oilseeds
- Know the different uses of byproducts obtained from cereals, pulses and oilseed

Theory

Module I:

Cleaning and grading, aspiration, scalping; size separators, screens, sieve analysis, capacity and effectiveness of screens. Various types of separators: specific gravity, magnetic, disc, spiral, pneumatic, inclined draper, velvet roll, colour sorters. Size reduction: principle, Bond's law, Kick's law, Rittinger's law, procedure (crushing, impact, cutting and shearing), Size reduction machinery: Jaw crusher, Hammer mill, Plate mill, Ball mill. Material handling equipment. Types of conveyors: Belt, roller, chain and screw. Elevators: bucket, Pneumatic conveying.

Practice:

Performance evaluation of different types of cleaners and separators; Determination of separation efficiency; Study of different size reduction machines and performance evaluation; Study of different types of conveying and elevating equipments,

Module II:

Drying: moisture content and water activity; Free, bound and equilibrium moisture content, isotherm, hysteresis effect, EMC determination, Psychrometric chart and its use in drying, Drying principles and theory, Thin layer and deep bed drying analysis, Falling rate and constant rate drying periods, maximum and decreasing drying rate period, drying equations, Mass and energy balance, Different types of grain dryers: bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray.

Practice:

Performance evaluation of different types of cleaners and separators; Determination of separation efficiency; Determination of fineness modulus and uniformity index; Study of different size reduction machines and performance evaluation; Determination of fineness modulus and uniformity index; Study of different types of conveying and elevating equipments,

Module III:

Milling of rice: Conditioning and parboiling, advantages and disadvantages, traditional methods, CFTRI and Jadavpur methods, Pressure parboiling method, Types of rice mills, Modern rice milling, different unit operations and equipment. Milling of wheat, unit operations and equipment. Milling of pulses: traditional

	milling methods, commercial methods, pre-conditioning, dry milling and wet milling methods: CFTRI and Pantnagar methods. Pulse milling machines, Milling of corn and its products. Dry and wet milling. Milling of oilseeds: mechanical expression, screw press, hydraulic press, solvent extraction methods, preconditioning of oilseeds, refining of oil. **Practice:** Measurement of moisture content: dry basis and wet basis; Study on drying characteristics of grains and determination of drying constant; Determination of EMC (Static and dynamic method); Study of various types of dryers; Study of different equipments in rice mills and their performance evaluation; Study of different equipments in pulse mills and their performance evaluation; Study of different equipments in oil mills and their performance evaluation; Type of process flow charts with examples relating to processing of cereals pulses and oil seeds; Visit to rice mill, pulse mill and oil mill. **Module IV:** Mixing: Theory of mixing of solids and pastes, Mixing index, types of mixers for solids, liquid foods and pastes. Extrusion cooking: principle, factors affecting, single and twin screw extruders. By-products utilization of rice milling. **Practice:** Study of different types of mixers; Study of different type of extruder **Suggested Reading** 1. Chakraverty, A. Post Harvest Technology of cereals, pulses and oilseeds. Oxford & IBH publishing Co. Ltd., New Delhi. 2. Dash, S.K., Bebartta, J.P. and Kar, A. Rice Processing and Allied Operations. Kalyani Publishers, New Delhi. Sahay, K.M. and Singh, K.K. 1994. Unit operations of Agricultural Processing. Vikas Publishing house Pvt. Ltd. New Delhi. 3. Geankoplis C. J. Transport processes and unit operations, Prentice Hall of India Pvt Ltd, New Delhi Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K. 4. Henderson, S.M., and Perry, R. L. Agricultural Process Engineering, Chapman and hall, London McCabe, W.L., Smith J.C. and Harriott, P. Unit operations of Chemical Engineering. McGraw Hill. Singh, R. Paul. and Heldman, R.Dennis. 2004. Introduction to Food Engineering. 3rd Edition. Academic Press, London. **Courseware link: https://courseware.cutm.ac.in/courses/cutm2066-post-harvest-engineering-of-cereals-pulses-and-oilseeds/**		
2	**CUTM1128**	**Engineering Properties of Agricultural Produce**	**2 (1+1+0)**
	Course Objectives • To make students understand the basic theoretical aspects and importance of engineering properties of agricultural produce • To learn the physical and thermophysical properties of agricultural materials.		

- To learn the requirement of engineering properties of materials for analysis and design of agricultural food and biological systems.

Course Outcomes

- Identify engineering properties of Agricultural materials.
- Explain related measurement methods.
- Relate engineering properties of food and agricultural materials to process design and quality control.

Course Syllabus

MODULE I:

Introduction, Classification, and the importance of engineering properties in the design of agricultural machinery. Physical Properties: shape, size, roundness, sphericity, volume, density, porosity, specific gravity, the surface area of grains, fruits, and vegetables.

Practice:

Determination of the shape and size of grains, fruits, and vegetables; Determination of bulk density of grains, fruits, and vegetables; Determination of angle of repose of grains, cereals, and pulses; Determination of the particle density and bulk density of solid grains; Determination of porosity of solid grains.

MODULE II:

Thermal properties: Heat capacity, Specific heat, Thermal conductivity, Thermal diffusivity, Heat of respiration; Co-efficient of thermal expansion.

Practice:

Determination of specific heat of different types of grain; Determination of Thermal Conductivity of grains by formula methods.

MODULE – III:

Frictional Properties: Friction in agricultural materials; Static friction, Kinetic friction, rolling resistance, angle of internal friction, angle of repose, Flow of bulk granular materials, Aerodynamic Properties: Aerodynamics of agricultural products, drag coefficients, terminal velocity.

Practice:

Determination of the co-efficient of external and internal friction of grains using the different surfaces; Finding out the terminal velocity of the grain sample and study the separating behavior in a vertical wind tunnel.

MODULE IV:

Rheological properties: force, deformation, stress, strain, elastic, plastic and viscous behavior, Newtonian and Non-Newtonian liquid, Visco-elasticity, Newtonian and Non-Newtonian fluid, Pseudo-plastic, Dilatant, Thixotropic, Rheopectic and Bingham Plastic Foods, Flow curves. Electrical properties: dielectric loss factor, loss tangent, A.C. conductivity and dielectric constant, method of determination.

Practice:

Determination of hardness of food material; Determination of Dielectric constant by formula method.

Book References:

1) Rao, M.A. and Rizvi, S.H., 1995. Engineering Properties of Foods. Marcel

	Dekker Inc. New York. 2) Singhal OP & Samuel DVK. 2003. Engineering Properties of Biological Materials. Saroj Prakashan. 3) Prentice, J.H. 1984. Measurement in Rheological Properties of Food Stuffs. Elsevier Applied Science Pub. Co. Inc. New York. 4) Mohesin, N.N. 1980. Thermal Properties of Foods and Agricultural Materials. Gordon & Breach Science Publishers, New York. **Courseware link:** http://courseware.cutm.ac.in/courses/engineering-properties-of-agricultural-produce/		
3	**CUTM1129**	**Watershed Hydrology**	**2 (1+1+0)**
	Course Objectives • To comprehend basic concepts of the hydrologic cycle. • To analyse precipitation data in detail, including assessment and instruments of precipitation data. • To understand the concept of hydrograph and unit hydrograph. • To understand methods to calculate runoff using empirical formulae and concept of flood routing. **Course Outcomes** • To explain the physical processes that govern the movement of surface water within a watershed. • To learn methods used to measure inputs and outputs of water in physical hydrological conditions. • To learn the about hydrograph and flood routing. **Course Syllabus** **Module I:** Introduction and Hydrologic cycle; Precipitation and its forms along with rainfall measurement. **Practice:** Visit to meteorological observatory and study of different instruments. **Module II:** Frequency analysis of point rainfall. Mass curve, hyetograph, depth-area-duration curves and intensity-duration-frequency relationship; Abstractions of Precipitation, Infiltration -factors, measurement and indices. Evaporation - Estimation and measurement. **Practice:** Design of rain gauge network and exercise on IDF curves; Analysis of rainfall data and estimation of mean rainfall by different methods; Exercise on frequency analysis of hydrologic data and estimation of missing data and test for consistency of rainfall records. **Module III:** Runoff - Factors , measurement, stage - discharge rating curve, estimation of peak runoff rate and volume and SCS curve number method; Geomorphology of watersheds.		

	Practice: Exercise on computation of infiltration indices; Computation of peak runoff and runoff volume by Cook's method and rational formula; Computation of runoff volume by SCS curve number method. **Module IV:** Hydrograph - Components, base flow separation; Unit hydrograph theory, S-curve, synthetic hydrograph, applications and limitations; Flood routing – channel and reservoir routing; Flood and Drought-Classification and management strategy. **Practice:** Study of stream gauging instruments - current meter and stage level recorder; Exercise on geomorphic parameters of watersheds and runoff hydrograph; Exercise on unit hydrograph. **Courseware link:** http://courseware.cutm.ac.in/courses/watershed-hydrology/		
4	**CUTM1130**	**Tractor and Automotive Engines**	**3 (2+1+0)**
	Course Objectives • Study of internal combustion engine specially a tractor engine keeping a view of upcoming trades and identify different components of each system of internal combustion. **Course Outcomes** • Provided knowledge about different types of engines, their types and usefulness. • Knowledge about working principle of different systems of internal combustion engines and tractor, used for higher studies. • Study the problem-solving methods for adjustment of different engine systems. **Course Syllabus** **Module I:** Study of sources of farm power –conventional & non-conventional energy sources Classification of tractors and IC engines; Thermodynamic principles of IC engine, Valve timing diagram and valve clearance adjustment, Study of detonation and knocking in IC engines, Engine performance curves, Study of engine components their construction, operating principles and functions; Study of mechanical, thermal and volumetric efficiencies; Study of engine strokes and comparison of and CI and SI engines; 6-stroke engine- its importance and functions. **Practice:** Recent improvements in design of an IC engine; Bharat 6 Engines-its importance; Study of 6 stroke cycle engines, its importance and function; Calculation of engine power and comparison of different tractors based open the power value and study of each component that creates the differences **Module II:** Study of Engine Valve systems; Study of importance of air cleaning system; Study of fuels, properties of fuels, calculation of air-fuel ratio; Study of tests on fuel for SI and CI engines; Study of carburetion system, carburetors and their main functional components. **Practice:**		

	Study of fuel injection system, fuel injection pump and engine governing **module III** Study of fuel injection system; What is Bharat 6 Engine- Its importance and comparison between Bharat-4 and Bharat-6 engine? Engine governing – need of governors, governor types and governor characteristics; Study of lubrication system **practice:** Study of lubrication & engine governing system **Module-IV:** Engine cooling system; Study of need and type of thermostat valves; Study of ignition system of SI engines; Study of electrical system in engine; Familiarization with the basics of engine testing. **Practice:** Study of cooling system thermostat and radiator performance evaluation and engine starting and electrical system **Suggested Reading:** 1) Tractor and its power units, Author-Liljedahl J B and Others 2) Farm Tractors, Author- S.C Jain and C.R. Rai. 3) Elements of Agricultural Engineering, Author- J. Sahay. 4) A numerical approach in agricultural engineering by Sanjaya Kumar **Courseware link:** http://courseware.cutm.ac.in/courses/tractor-and-automotive-engine/		
5	**CUTM1131**	**Irrigation Engineering**	**3 (2+1+0)**
	Course Objectives • To make students familiar with the crop consumptive use, Irrigation requirement of crops and irrigation methodologies implemented in farm. **Course Outcomes** • Students would be familiar to find out crop consumptive use and water requirement of crops. • They also be able to design the irrigation channel and would be knowing about irrigation losses and measures to mitigate those loses **Course Syllabus** **Module I:** Major and medium irrigation schemes of India, purpose of irrigation, environmental impact of irrigation projects, source of irrigation water, present status of development and utilization of different water resources of the country; measurement of irrigation water: weir, flumes and orifices and other methods; **Practice:** Measurement of irrigation water **Module II:** open channel water conveyance system: design and lining of irrigation field channels, on farm structures for water conveyance, control & distribution; underground pipe conveyance system: components and design; **Practice:**		

	Determination of bulk density, field capacity and wilting point; study of advance, recession and computation of infiltration opportunity time **Module III:** Depth of irrigation, frequency of irrigation, irrigation efficiencies; surface methods of water application: border, check basin and furrow irrigation- adaptability, specification and design considerations. **Practice:** Estimation of irrigation efficiency **Module IV:** soil water plant relationship: soil properties influencing irrigation management, soil water movement, infiltration, soil water potential, soil moisture characteristics, soil moisture constants, measurement of soil moisture, moisture stress and plant response; water requirement of crops: concept of evapotranspiration (ET), measurement and estimation of ET, water and irrigation requirement of crops **Practice:** Measurement of infiltration characteristics; Determination of bulk density, field capacity and wilting point; Estimation of evapotranspiration **Suggested Reading** 1) Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing House New Delhi. 2) Allen R. G., L. S. Pereira, D. Raes, M. Smith. 1998. Crop Evapotranspiration guidelines for computing crop water requirement. Irrigation and drainage Paper 56, FAO of United Nations, Rome. **3)** Murthy VVN. 2013. Land and Water Management Engineering. Kalyani Publishers, New Delhi. **Courseware link:** http://courseware.cutm.ac.in/courses/irrigation-engineering/		
6	**CUTM1132**	**Tractor Systems and Controls**	**3 (2+1+0)**
	Course Objectives • To enable the students for acquiring knowledge pertaining to systems like transmission system, steering and brake system, power outlets like P.T.O.& draw-bar, stability testing of tractor and ergonomics with a view of current trades. **Course Outcomes** • Gaining knowledge about various tractor systems, their construction and working. • Enhancing higher study scope in tractor chassis design and traction theory • Problem solving skills like study of ergonomial and safety considerations in Tractor **Course Syllabus** **Module I:** Discuss about latest development of tractor, Introduction to transmission systems, working principles of Clutch & construction, Familiarization with single plate, multiple plate, centrifugal and dual clutch systems, Analysis & Calculations of		

	number of clutch plates of Clutch, Calculation for braking torque, Types and construction details of gear boxes. Working principle of gear change and gear shifting. Working principle of differential system and its construction. Details about final drive. **Practice:** Showing the cut section model of a tractor to acquaint with the operation of various systems of tractor &study of latest developments in tractor; Introduction to transmission systems and components; Study of clutch functioning, parts and different types of gear box **Module II:** Types and construction details of brake system. Working principle of different brakes. Steering system _ Necessity, Steering Geometry. Analysis of steering-Turning radius and true rolling condition, Ackerman steering, Working principle and basic components of hydraulic system. Types of hydraulic systems, hitch and control board of tractor hitch. Hydraulic steering. Tractor power outlets-study of P.T.O. and standards. **Practice:** Study of brake systems and some design problems; Steering geometry adjustments and Toe-in and toe out determination; Study of hydraulic systems in a tractor **Module III:** Tractor tyres and Determination of Centre of Gravity of wheeled and track type tractors on level ground. Traction and related definitions, Study of pneumatic tyres, tyres construction and specification, traction aids, Determination of moment of inertia of tractor, tractor stability specially at turns, Introduction to tractor testing mechanics of a rigid wheel (traction and towed), Analysis of tractor in static conditions. Ergonomics considerations of tractor design. Operational safety features of tractor. **Practice:** Tractor driving **Suggested Reading:** 1) Tractor and its power units, Author-Liljedahl J B and Others 2) Farm Tractors, Author- S.C Jain and C.R. Rai. 3) Elements of Agricultural Engineering, Author- J. Sahay. 4) A numerical approach in agricultural engineering by Sanjaya Kumar **Courseware link:** http://courseware.cutm.ac.in/courses/tractor-and-automotive-engine/		
7	**CUTM1133**	**Farm Machinery and Equipment-I**	**3 (2+0+1)**
	Course Objectives • To impart knowledge on primary and secondary tillage implements along with earth moving machinery and seeding, planting, transplanting equipments. **Course Outcomes** • To identify the need of farm mechanization in India. • To equip the students with technical knowledge and skills required for the operation of Tillage, Sowing and transplanting equipments needed for		

	agricultural farms. • To know about the cost of operations and economics of the machines. **Course Syllabus** **Module I:** Present Status and Scope of farm mechanization. Comparison of ownership with hiring of machines, Identification and selection of machines for various operations on the farm. Hitching systems and controls of farm machinery. Force analysis of tillage tools and their measurement. Types of dynamometer-spring hydraulic, eddy current and strain gauge types. **Module II:** Calculation of field capacities and field efficiency. Calculations for economics of machinery usage. Familiarization with land reclamation and earth moving equipment. Introduction to machines used for primary tillage, secondary tillage, rotary tillage, deep tillage and minimum tillage. Measurement of draft and power requirement for the tillage machines. **Module III:** Constructional details of tillage machines like mould-board plough, disc plough, chisel plough, rotavators, sub-soiler, harrows, cultivators. Familiarization with sowing, planting & transplanting equipment. Constructional details of seed drills, no-till drills, and strip-till drills. **Module IV:** Familiarization with planters, bed-planters and other planting equipment. Study of types of furrow openers and metering systems in drills and planters. Calibration of seed-drills/ planters. Materials of construction& heat treatment processes and their Properties used in agricultural machines. Introduction to steels and alloys for agricultural application. **Project:** Familiarization with different farm implements and tools. Study of hitching systems, . Field capacity and field efficiency measurement for at least two machines/implements. Study of primary and secondary tillage machinery – Construction details, adjustments and working of M.B. plow, disc plow and disc harrow and secondary tillage tools. Construction and working of rotavators and other rotary tillers, measurement of speed & working width. calculations of power and draft requirements. Study of sowing and planting equipment – construction, types, calculation for calibration and adjustments. Working of seed-cum-fertilizer drills, planters and their calibration in field. Study of transplanters – paddy, vegetable, etc. Construction and working of rice and crop transplanters for potato, sugarcane, cotton etc., and their field operation patterns. **Suggested Reading** 1) Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery. Smith HP and LH Wilkey. Farm Machinery and Equipment. 2) Culpin Claude. Farm Machinery. 3) Srivastava AC. Elements of Farm Machinery. 4) Lal Radhey and AC Datta. Agricultural Engineering. **Courseware link:**

	http://courseware.cutm.ac.in/courses/farm-machinery-and-equipment-i/		
8	**CUTM1134**	**Agricultural Structures and Environmental Control**	**2 (1+0+1)**

Course Objectives

- To make students familiar with different farm structures with environmental control parameters
- To Understand the importance of planning and lay out of a farmstead
- Know about various standards for various dairy, piggery, poultry and other farm structures.
- Know about rural electrification, concepts of ecosystem, bio-diversity, environmental pollution and control, solid waste, plant waste management

Course Outcomes

- To prepare estimate for different farm buildings, structures, roads, fencing and construction, repair and maintenance of farm structures
- Design and layout of farm buildings, poultry houses, goat houses, bio-gas plant, farm roads, fencing etc.
- Measure different environmental parameters and indicators, ventilation, air temperature, cooling load of farm buildings

Course Syllabus

Module I:

Planning and layout of farmstead. Scope, importance and need for environmental control, physiological reaction of livestock environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods.

Project:

Prepare a Seminar on different parameters and controls affecting Livestock reaction.

Module II:

Livestock production facilities, BIS Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures, animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, and poultry.

Project:

Design and layout of a dairy farm; Design and layout of a poultry house; Design and layout of a goat house/sheep house

Module III:

Storage of grains, Causes of spoilage, Water activity for low and high moisture food and its limits for storage, Moisture and temperature changes in grain bins; Traditional storage structures and their improvements, Improved storage structures, Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins, Storage of seeds.

Project:

Design of a feed/fodder storage structures; Design of grain storage structures; Design and layout of commercial bag and bulk storage facilities; Study of different domestic storage structure

	Module IV: Rural living and development, rural roads, their construction cost and repair and maintenance. Sources of water supply, norms of water supply for human being and animals, drinking water standards and water treatment suitable to rural community. Site and orientation of building in regard to sanitation, community sanitation system; sewage system and its design, cost and maintenance, design of septic tank for small family. Estimation of domestic power requirement, source of power supply and electrification of rural housing. **Project:** Estimation of a Farm building; Measurements for environmental parameters and cooling load of a farm building 1) **References:** Pandey, P.H. Principles and practices of Agricultural Structures and Environmental Control, Kalyani Publishers, Ludhiana. 2) Sahay, K.M. and Singh, K.K. Unit Operations of Agricultural Processing, Vikas publishing pvt. Ltd, Noida. **Courseware link:** http://courseware.cutm.ac.in/courses/agricultural-structures-and-environment-control/		
9	**CUTM1135**	**Sprinkler and Micro Irrigation Systems**	**2 (1+1+0)**
	Course Objectives • To make students familiar with different micro irrigation systems. • Learn the various layout and design along with fertilizer application through these systems. **Course Outcomes** By learning the topic student will be able to know the: • Design of sprinkler irrigation and its types. • Design of drip irrigation system and its types. • Fertigation its advantages and limitations. **Course Syllabus** **Module I:** Sprinkler adaptability, Prospects and Problems; Types of Sprinkler Irrigation System **Practice:** Components of sprinkler irrigation system; Installation of sprinkler irrigation system **Module II:** Design of sprinkler irrigation system: layout selection, hydraulic design of lateral, sub-main and main pipe line, design steps; Selection of pump and power unit for sprinkler irrigation; performance evaluation of sprinkler irrigation system: uniformity coefficient and pattern efficiency; **Practice**		

	Determination of moisture distribution pattern and uniformity coefficient; Design of sprinkler irrigation system. **Module III:** Micro Irrigation Systems: types-drip, spray, & bubbler systems, merits and demerits, different components; Design of drip irrigation system: general considerations, wetting patters, irrigation requirement, emitter selection, hydraulics of drip irrigation system, design steps; necessary steps for proper operation of a drip irrigation system. **Practice:** Installation of drip irrigation system; Design of drip irrigation system **Module IV:** fertigation: advantages and limitations of fertigation, fertilizers solubility and their compatibility, precautions for successful fertigation system, fertigation frequency, duration and injection rate, methods of fertigation. **Practice:** Determination of rate of fertilizer application **Suggested Reading** 1) Michael A.M. 2012. Irrigation: Theory and Practice. Vikas Publishing Vikas Pub. House New Delhi. 2) Keller Jack and Bliesner Ron D. (2001). Sprinkle and Trickle Irrigation. Springer Science business Media, New York. **Courseware link:** http://courseware.cutm.ac.in/courses/sprinkler-and-micro-irrigation/		
10	**CUTM1136**	**Soil-Water Conservation Engineering and Structure**	**4 (3+0+1)**
	Course Objectives • To have an understanding about the degradation of productive soil and the causes of its erosion. • To make the students understand about the measurement techniques for soil loss and wind erosion. • To know the different agronomical and engineering measures adopted for its control along with its design. • To study the design of various gully control structures and water harvesting structures **Course Outcomes** • After learning the topic a student will be able to know about- The various types of soil, water and wind erosion along with its mitigation measures. • The agronomic and engineering methods of conservation and the design of bunds and terraces being implemented on the field. • Minimize the erosion loss by different structures and conservation of soil. **Course Syllabus** **Module-I:**		

	Soil erosion – Introduction; Causes and types of erosion; Agents, Factors, Effects causing erosion; Water erosion - Mechanics and forms of erosion; Stream bank erosion; Gully Classification and Stages of gully development. **Practice:** Visit to soil erosion sites and watershed project areas for studying erosion control and water conservation measures; Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE. **Module II:** Runoff harvesting – short-term and long term; Roof top rain water Harvesting; Soil loss estimation – Universal soil loss equation (USLE) and modified USLE; Erosivity and Erodibility; Rainfall erosivity - estimation by KE>25 and EI30 methods; Water erosion control measures - agronomical measures; Engineering measures– Contour Bunds and Graded Bunds, Terraces-Broad Based and Bench terrace. **Practice:** Computation of soil erodibility index in soil loss estimation; Exercises on computation of rainfall erosivity index; Design and layout of contour bunds; Design and layout of graded bunds; Design and layout of bench terrace. **Module III:** Gully Control measures; Permanent structures for soil conservation-Drop spillway-parts and components; Chute spillway -parts and components; Drop inlet spillway-parts and components. **Practice:** Design of drop spillway; Design of chute spillway; Field visit to watershed project areas treated with soil and water conservation measures; Hydrologic, hydraulic and structural design of spillway. **Module IV:** Hydraulic jump and its application; Grassed waterways and design; Wind erosion-Factors affecting, mechanics; Sediment Transportation; Land capability classification; Percolation pond - site selection, design and construction details; Farm pond -components, site selection, capacity. **Practice:** Design of vegetative waterways **Courseware link:** http://courseware.cutm.ac.in/courses/soil-water-conservation-engineering-and-structures/		
11	**CUTM1137**	**Watershed Planning and Management**	**2 (1+1+0)**
	Course Objectives To give the students overall idea about: • Proper use of all available resources of a watershed for optimum production with minimum hazards to natural resources. • Relate interdisciplinary topics such as the use of public policies, regulations, and management tools to effectively manage water resources for a sustainable future.		

	Course Outcomes These educational objectives are supported by a curriculum that seeks to have its graduates achieve the following student outcomes: • Understand the concepts of watershed management and its effect on land, water and ecosystem resources • Analyze public policies and practices of watershed planning Assess the impact of watershed planning through case studies • Develop control and mitigation techniques for watershed problems **Course Syllabus** **Module I:** Watershed Planning and Management; Characterization of watershed **Practice:** Study of functional requirement of watershed development structures; Study of watershed management technologies. **Module II** Watershed management - concept, objectives, factors; Delineation of Watershed; Coding of Watershed **Module III** Water budgeting in a watershed; Integrated watershed management - concept and components **Practice:** Analysis of hydrologic data for planning watershed management; Prioritization of watersheds. **Module IV:** Dryland farming and Agriculture **Practice:** Practice on softwares for analysis of hydrologic parameters of watershed; Visit to watershed development project areas. **Suggested Readings** 1) Katyal, J.C., R.P. Singh, Shriniwas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field Manual on Watershed Management. CRIDA, Hyderabad. 2) Mahnot,Ghanshyam Das. 2008. Hydrology and Soil Conservation Engineering: Including Watershed Management. 2nd Edition, Prentice-Hall of India Learning Pvt. Ltd., New Delhi. **Courseware link:** http://courseware.cutm.ac.in/courses/watershed-planning-and-management/		
12	**CUTM1138**	**Drainage Engineering**	**2 (1+1+0)**
	Course Objectives • To make students familiar with salinity and water logging situations prevailing in agricultural lands and measures to mitigate them **Course Outcomes** • Students would be able to design suitable surface and sub-surface drainage pipes for agricultural lands and would be introduced to computer models		

	for designing the drainage pipes **Course Syllabus** **Module I:** Water logging- causes and impacts; Drainage, objectives of drainage, familiarization with the drainage problems of the state **Module II:** Salt balance, reclamation of saline and alkaline soils; leaching requirements, conjunctive use of fresh and saline water **Module III:** Surface drainage coefficient, types of surface drainage, design of surface drains; **Practice:** In-situ measurement of hydraulic conductivity by single auger hole and inverse auger hole method; Estimation of drainage coefficients; Determination of drainable porosity; design of surface drainage systems; **Module IV:** Sub-surface drainage: purpose and benefits, investigations of design parameters hydraulic conductivity, Drainable porosity, water table; Derivation of Hooghoudt's and Ernst's drain spacing equations; design of subsurface drainage system; **Practice:** Installation of piezometer and observation wells; Preparation of iso-bath and isobar maps; Design of subsurface drainage systems; Design of gravel envelop. **Suggested Reading** 1) NRCS Part 650 (Engineering Field Handbook): Chapter 14 2) Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles , Methods and Applications. Vikas Publication House, Noida (UP) **Courseware link:** http://courseware.cutm.ac.in/courses/drainage-engineering/		
13	**CUTM 1139**	**Farm Machinery and Equipment-II**	**3 (2+0+1)**
	Course Objectives • To enable the students to understand the basic principles of plant protection equipment, cutting mechanism on various harvesting machines, working principles of threshers, harvesting of field and horticultural crops. **Course Outcomes** • To equip the students with technical knowledge of plant protection and intercultural equipments. • To train the students with skills required for the operation, maintenance and evaluation of harvesting, threshing machineries needed for agricultural farms. • To abreast the students with mathematical, experimental and computational skills for solving different field problems. **Course Syllabus** **Module I:** Introduction to plant protection equipment – sprayers and dusters. Classification of sprayers and sprays. Types of nozzles. Calculations for calibration of sprayers.		

	Introduction to interculture equipment. Use of weeders – manual and powered. Study of functional requirements of weeders and main components. Familiarization of fertilizer application equipment. **Module II:** Study of harvesting operation – harvesting methods, harvesting terminology. Study of mowers – types, constructional details, working and adjustments. Study of shear type harvesting devices – cutter bar, inertial forces, counter balancing, terminology, cutting pattern. Study of reapers, binders and windrowers – principle of operation and constructional details. Importance of hay conditioning, methods of hay conditioning. Introduction to threshing systems – manual and mechanical systems. **Module III:** Types of threshing drums and their applications. Types of threshers- tangential and axial, their constructional details and cleaning systems. Study of factors affecting thresher performance. Study of grain combines, combine terminology, classification of grain combines, study of material flow in combines. Computation of combine losses, Study of chaff cutters and capacity calculations. **Module IV:** Study of straw combines – working principle and constructional details. Study of root crop diggers – principle of operation, blade adjustment and approach angle, and calculation of material handled. Study of potato and groundnut diggers. Study of Cotton harvesting – Cotton harvesting mechanisms, study of cotton pickers and strippers, functional components. Study of maize harvesting combines. Introduction to vegetables and fruit harvesting equipment and tools. **Project:** Familiarization with plant protection and interculture equipment. Study of sprayers, types, functional components. Study of dusters, types and functional components. Study of nozzle types and spread pattern using patternator. Familiarization with manual and powered weeding equipment and identification of functional components. Study of fertilizer application equipment including manure spreaders and fertilizer broadcasters. Study of various types of mowers, reaper, reaper binder. Study of functional components of mowers and reapers. Familiarization with threshing systems, cleaning systems in threshers. Calculations of losses in threshers. Familiarization with functional units of Grain combines and their types. Calculations for grain losses in a combine. Study of root crop diggers and familiarization with the functional units and attachments. Familiarization with the working of cotton and maize harvesters. Familiarization with vegetable and fruit harvesters. **Suggested Reading** 1) Kepner RA, Roy Barger & EL Barger. Principles of Farm Machinery. 2) Smith HP and LH Wilkey. Farm Machinery and Equipment. 3) Culpin Claude. Farm Machinery. S 4) rivastava AC. Elements of Farm Machinery. 5) Lal Radhey and AC Datta. Agricultural Engineering Principles of Farm Machinery. **Courseware link:**

	http://courseware.cutm.ac.in/courses/farm-machinery-and-equipment-ii/		
14	**CUTM1140**	**Post-Harvest Engineering of Horticultural Crops**	**2 (1+0+1)**

Course Objectives

- Know the different means of storage and value addition of fruits and vegetables along with the cold chain.
- Know the different unit operations in the processing of major horticultural crops of the country and state.
- Understand the working principles of different types of machinery used for the processing of fruits, vegetables and spices.
- Understand the basics of the selection of appropriate machines/equipment for various applications of processing of horticultural crops

Course Outcomes

- Use the different types of sorting, grading, peeling, slicing, blanching and other equipment for processing of fruits and vegetables.
- Identify the suitable equipment, materials, and methods for storage, processing, packaging, and value addition of fruits and vegetables.
- Develop at least 4 types of value-added products from fruits and vegetables.
- Understand the technical and management aspects of the operation of fruits and vegetable processing industries.

Course Syllabus

Module I:

Importance of processing of fruits and vegetables, spices, condiments and flowers. Characteristics and properties of horticultural crops important for processing, Peeling: Different peeling methods and devices (manual peeling, mechanical peeling, chemical peeling, and thermal peeling), Slicing of horticultural crops: equipment for slicing, shredding, crushing, chopping, juice extraction.

Project:

Performance evaluation of peeler and slicer; Performance evaluation of juicer and pulper

Module II:

Blanching: Importance and objectives; blanching methods, effects on food (nutrition, colour, pigment, texture), Chilling and freezing: Application of refrigeration in different perishable food products, Thermophilic, mesophilic & Psychrophilic micro- organisms, Chilling requirements of different fruits and vegetables, Freezing of food, freezing time calculations, slow and fast freezing, Equipment for chilling and freezing (mechanical & cryogenic), Effect on food during chilling and freezing, Cold storage heat load calculations and cold storage design, refrigerated vehicle and cold chain system, Dryers for fruits and vegetables, Osmo- dehydration.

Project:

Performance evaluation of blanching equipment; Testing adequacy of blanching; Study of rehydration characteristics of freeze dried vegetables; Optimization of Osmo-dehydration of vegetables.

	Module III: Packaging of horticultural commodities, Packaging requirements (in terms of light transmittance, heat, moisture and gas proof, micro-organisms, mechanical strength), Different types of packaging materials commonly used for raw and processed fruits and vegetables products, bulk and retail packages and packaging machines, handling and transportation of fruits and vegetables, Pack house technology, Minimal processing, Common methods of storage, Low temperature storage, evaporative cooled storage, Controlled atmospheric storage, Modified atmospheric packaging. **Project**: Study of cold storage and its design; Study of CAP and MAP storage **Module IV:** Preservation Technology, General methods of preservation of fruits and vegetables, Brief description and advantages and disadvantages of different physical/ chemical and other methods of preservation, Flowcharts for preparation of different finished products, Important parameters and equipment used for different unit operations, Post-harvest management and equipment for spices and flowers, Quality control in Fruit and vegetable processing industry. Food supply chain. **Project**: Prepare a list of Preservatives used for preparation of value added product; Presentation on spice processing methods. **References:** 1) Sudheer, K P. and Indira, V. 2007. Post-Harvest Engineering of Horticultural Crops. New India Publishing House. 2) Fellows, P. 2008. Food Processing Technology, Woodhead. 3) Pandey, R.H. 1997. Postharvest Technology of fruits and vegetables (Principles and practices). Saroj Prakashan, Allahabad. 4) Lal Giri dhari, Siddappa and Tondon. 2001. Preservation of fruits and vegetables. ICAR, New Delhi. 5) Srivastava and Sanjeev Kumar. 2008. Fruit and vegetable preservation: principles and practices. Kalyani Publishers. **Courseware link:** http://courseware.cutm.ac.in/courses/post-harvest-engineering-of-horticultural-crops/		
15	**CUTM1141**	**Groundwater, Wells and Pumps**	**3 (2+1+0)**
	Course Objectives • To get concept of various surface and subsurface geophysical methods for groundwater explorations • To know about well hydraulics • To know about design principles of well • To understand concept for groundwater management and modelling **Course Outcomes** These educational objectives are supported by a curriculum that seeks to have its graduates achieve the following student outcomes: • Various components of hydrologic cycle that affect the movement of water in		

	the earth. • Various Stream flow measurements technique, the concepts of movement of ground water beneath the earth • Apply math, science, and technology in the field of water resource Engineering. **Course Syllabus** **Module I:** Occurrence and movement of ground water; Aquifer and its types; Classification of wells, fully penetrating tube wells and open wells, familiarization of various types of bore wells; Design of tube well and gravel pack, installation of well screen, Well Completion, development and maintenance of well. **Practice** Study of different drilling equipments; Sieve analysis for gravel and well screens design **Module II:** Pumping System; Groundwater hydraulics; Confined and Unconfined Aquifer. **Practice** Coopers-Jacob method, Chow method; Theis Recovery method; Well losses and well efficiency; Study of artificial ground water recharge structures **Module III:** Pumping systems: water lifting devices; different types of pumps; Component and parts of centrifugal pumps; Working of Centrifugal pump; Submersible pump **Practice** Estimating ground water balance; Study of radial flow and mixed flow centrifugal pumps; Installation of centrifugal pump; testing of centrifugal pump and study of cavitations. **Module IV:** Groundwater exploration techniques; Hydraulic ram and its charcteristics; Well Interference; Pumps and types. **Practice** Study of Hydraulic ram; Study of Propeller and axial pumps **Suggested Readings** 1) Groundwater Hydrology, 3rd Edition, John Wiley & Sons, New York (International Book Distributing Company Lucknow). Michael AM. and Ojha TP. 2014. 2) Michael AM, Khepar SD. and SK Sondhi. 2008. Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill. Todd David Keith and Larry W. Mays. 2004. Michael AM, Khepar SD. and SK Sondhi. 2008. 3) Water Well and Pumps, 2nd Edition, Tata Mc-Graw Hill. Todd David Keith and Larry W. Mays. 2004. Michael AM, Khepar SD. and SK Sondhi. 2008. **Courseware link:** http://courseware.cutm.ac.in/courses/groundwater-wells-pump/		
16	**CUTM1142**	**Tractor and Farm Machinery Operation and Maintenance**	**2 (0+2+0)**
	Course Objectives		

- To make student learn about function and maintenance of tractor systems i.e. fuel injection, cooling and transmission system etc.
- To make student learn how to attach implements with the tractor and how to operate them.
- To make student learn about the adjustments required in agricultural implements before and during the operation.
- To make student learn that when to repair and when to replace the machine components and machine.

Course Outcomes

- Students will be able to identify different systems of tractor and know about their functioning.
- Students will be able attach various agricultural machinery with the tractor and can do the adjustments required for operation.
- Students will be able to do periodic maintenance of various components of tractor and machinery.
- Student will be able to learn how to replace the agricultural machinery components like furrow opener, plough bottom and rotavator blade.

Course Syllabus

Module I:

Familiarization with different makes and models of agricultural tractors; Identification of functional systems including fuels system, cooling system; transmission system, steering and hydraulic systems. Study of maintenance points to be checked before starting a tractor. Familiarization with controls on a tractor.

Module II:

Safety rules and precautions to be observed while driving a tractor. Driving practice of tractor. Practice of operating a tillage tool (mould-board/plough/ disc plough, rotavator) and their adjustment in the field. Study of field patterns while operating a tillage implement. Hitching & De-hitching of mounted and trail type implement to the tractor. Driving practice with a trail type trolley – forward and in reverse direction.

Module III:

Introduction to tractor maintenance – precautionary and break-down maintenance. Tractor starting with low battery charge. Introduction to trouble shooting in tractors. Familiarization with tools for general and special maintenance. Introduction to scheduled maintenance after 10, 100, 300, 600, 900 and 1200 hours of operation. Safety in tractor operation- road and field. Top end overhauling. Fuel saving tips. Preparing the tractor for storage. Care and maintenance procedure of agricultural machinery during operation and off-season. Repair and maintenance of implements – adjustment of functional parameters in tillage implements.

Module IV:

Replacement of broken components in tillage implements. Replacement of furrow openers and change of blades of rotavators. Maintenance of cutter bar in a reaper. Adjustments in a thresher for different crops. Replacement of V-belts on implements. Setting of agricultural machinery workshop.

	Reference books: 1) Diesel Engine Manual By Black PO and WE Scahill. 2) Tractor operation and maintenance By Southorn N. 3) Farm Tractor Maintenance and Repair By Jain SC and CR Rai. 4) Farm Tractor Systems: Operation and Maintenance By Segun R. Bello **Courseware link:** http://courseware.cutm.ac.in/courses/tractor-and-farm-machinery-operation-and-maintenance/		
17	**CUTM1143**	**Dairy and Food Engineering**	**3 (2+0+1)**
	Course Objectives • To impart knowledge on unit operations of dairy products and study of design and layout of dairy plants. **Course Outcomes** • Acquaint the students with various dairy engineering operations such as homogenization, pasteurization, thermal processing, evaporation, freezing, and drying of milk. • Understand the different types of equipment and their working principles used for processing and dairy and food products. • Learn to design a dairy plant layout. **Course Syllabus** **Module I:** Dairy development in India, Engineering, thermal and chemical properties of milk and milk products, Process flow chart for product manufacture, Principles and equipment related to receiving of milk. **Project:** Write a two-page note on dairy development in India and Orissa since independence. **Module II:** Principles, Equipment's, Controls used in Pasteurization, sterilization, homogenization, centrifugation, cream separation. Evaporation of food products: principle, types of evaporators, steam economy, multiple-effect evaporation, vapour recompression, Thermal Compression **Project:** Writing a term paper on Ultra High-Temperature Pasteurization of Milk: Kinetics of Microbial Destruction and Changes in Physico-chemical Characteristics. Estimation of cream yield by using Domestic cream separator present in Mini Dairy plant in CUTM Campus. Estimation of Steam Economy, Mass and Energy calculation in an Evaporator. **Module III:** Preparation methods and equipment for the manufacture of cheese, *paneer*, butter and ice cream, Different packaging material used for packaging of milk and milk products, filling of milk: Principle and Equipment for filling of Liquid milk, Pasty milk products, and power. **Project:**		

	Preparation of Paneer from different varieties of milk and compare the paneer yield. Estimation of packaging capacity and efficiency of form-fill-seal machine present in the Mini Dairy plant of CUTM Campus for packaging of milk. **Module IV:** Drying of liquid and perishable foods: principles of drying, vacuum tray drying, spray drying, drum drying, freeze-drying, Filtration: principle, types of filters; Membrane separation, RO, Nano-filtration, Ultrafiltration and Macro-filtration, equipment and applications. Dairy plant design and layout, Plant utilities **Project:** Preparation of dried mushroom in the Vacuum self-dryer and compare the rehydration quality with hot air tray dryer. Preparation of Freeze-dried bitter gourd and compared the rehydration quality with tray drying. Estimation of refrigeration requirements of Mini dairy plant present in the CUTM Campus. Prepare the layout of any dried vegetables manufacturing plant producing 100 kg product per day. **References:** 1) Ahmed, T. 1997. Dairy Plant Engineering and Management. 4th Ed. Kitab Mahal. 2) McCabe, W.L. and Smith, J. C. 1999. Unit Operations of Chemical Engineering. 3) Mc Graw Hill. Rao, D.G. Fundamentals of Food Engineering. PHI learning Pvt. Ltd. New Delhi. 4) Singh, R.P. & Heldman, D.R. 1993. Introduction to Food Engineering. Academic Press. 5) Toledo, R. T. 1997. Fundamentals of Food Process Engineering. CBS Publisher. **Courseware link:** http://courseware.cutm.ac.in/courses/dairy-food-process-engineering/

Basket-V Domain

(Domain, Internship, Projects: Choice Based)

(Total Credits: 28)

1.	CUFM	Smart Farm Machinery	28 (6-9-13)

Courses Division (list of all divisions):

1. Product Development Brief (0-1-1)
2. Sensor, Actuators and Robot Operating Systems (2-2-0)
3. Farm Machinery Design (2-0-1))
4. Piloting a Drone (1-2-0)
5. PLM using Dassault Tools (1-2-0)
6. Testing of Farm Machinery (0-2-1)
7. Product Development Project (0-0-10)

Domain Track Objectives:

1. To make student learn about the smart technologies and their application in farm machinery.
2. To make student learn how to design farm machinery and develop its 3D model in software.
3. To make student learn how to simulate the model using software.
4. To make student learn how to develop a prototype model and test it in rearl conditions.

Domain Track Course Outcomes:

1. Studnets will be able to think how to apply smart technologies in farm machinery.
2. Students will be able to design and simulate 3D model of machinery.
3. Students will be able to develop a prototype of smart machine based on farmers feedback.
4. Students will be able to test the machine in real field conditions.

Domain Syllabus:

1. Product Development Brief (0-2-1)

1.1 Customer or User Requirement for Specification (Gate 0)
1.2 Requirement gathering and feasibility study of the project
1.3 Understanding users' motivations and to gather deep insights about a product
1.4 Challenges and benefits of the products
1.5 Understanding the product through literature survey and available resources
1.6 Market analysis of existing products
1.7 Finalizing the product specification
1.8 Preparing a project plan

2. Sensors, Actuators and ROS (2-2-0)

2.1 Sensors: GPS, GSM, Bluetooth, Tilt
2.2 Biometric, Pulse bit.
2.3 Temperature, Humidity.
2.4 Actuators: DC Motor.
2.5 Stepper motor
2.6 Servo motor
2.7 Solenoid valve
2.8 Speed control of motors
2.9 Controller: Arduino
2.10 Sensor communication and data fetching.
2.11 Arduino programming with sensors.
2.12 Controlling of actuator using sensors and programming.
2.13 Operation and control of servo motor
2.14 Operation and control of stepper motor
2.15 Operation control of DC motor

	2.16 Output devices solenoid valves, relay, plunger 2.17 ROS & C++ 2.18 What is Ubuntu & ROS. 2.19 Requirement and application of ROS. 2.20 ROS based simulation of Turtlbot. 2.21 Adding of robot with wheel & sensor. 2.22 Placing robot inside Gazebo. 2.23 Ubuntu basic command. 2.24 Installation of Ubuntu, ROS & Gazebo. 2.25 Turtlbot control application. 2.26 Gazebo based robot control and simulation. 2.27 Python and C++ based programming to control robot. **3. Design of Farm Machinery (2-0-1)** 3.1 Basic design principles of farm machines, 3.2 Implements and tools. 3.3 Design of primary and secondary tillage implements, 3.4 Design of M.B. Plough 3.5 Design of Disc Plough, 3.6 Design of cultivator 3.7 Design of rotavator. 3.8 Design of seeders, 3.9 Design of planters 3.10 Design of transplanting machines, 3.11 Design of fertilizer distributors. 3.12 Design of intercultural equipment, 3.13 Design of plant protection equipment. 3.14 Design of harvesting machines, 3.15 Design of threshing machines for cereals and pulses. 3.16 Design of chaff cutting unit, 3.17 Design of cleaning and grading unit, 3.18 Presentation on design of smart farm machinery. **4. Piloting a Drone (1-2-0)** 4.1 Recognizes DGCA Safety Regulations & amp; 4.2 Develop safety attitude while flying Drones. 4.3 Identifies & amp; selection of different types of Drones & amp; 4.4 Fundamentals of Flight (Aerodynamics), 4.5 ATC procedures & amp; 4.6 Radio Telephony, 4.7 Different regulations of DGCA, 4.8 Civil Aviation Requirements, 4.9 Weather and meteorology. 4.10 Develop and apply knowledge of Airframes& amp; 4.11 Electric motors Propellers 4.12 Identification Selection of Electronic Speed Controllers (ESC) 4.13 Flight Controllers for Drones 4.14 Recognizes application of Batteries, Chargers, Connectors, Transmitters 4.15 Receivers, Cameras, GimbalsOther payloads. 4.16 Application of knowledge of Ground Control Stations FPV 4.17 Perform Assembling 4.18 MRO & battery care of Drones

	4.19 Identification & selection of basic operating features of a Drone Flight Simulator 4.20 Fly a Drone with instructor and then perform solo flight (Virtual reality training & live Drone flying). 4.21 Carry out entire flying operations from pre-flight 4.22 Checks to after flight checks while flying a drone in simulator training & live training. **5. PLM using Dassault Tools (1-2-0)** 5.1 System Engineering Dymola 5.2 Finding energetic dimension of the desired product 5.3 Designing system and subsystem using behaviour modelling work bench 5.4 Getting familiar with Dymola- modellica library. 5.6 Understanding the behaviour of the model through input n output data 5.7 Customizing the product properties 5.8 System Integration with product dimension. 5.10 Functional and logical design of integrated product in system engineering. 5.11 3-D Model using CATIA 5.12 CATIA part design of different components 5.13 Surface designing for creating high end complex design 5.14 Assembly Designing of the complete product 5.15 Wire routing and entire harnessing of the design. 5.16 Mechanical system Designing of the product 5.17 CATIA live rendering 5.18 Behaviour experience of the complete product. 5.19 Design validation/Simulation using Simulia 5.20 Simulation using Simulia 5.21 Classification of simulation 5.22 Structural simulation, Thermal simulation and both 5.23 Linear and nonlinear analysis 5.24 CFD Analysis, Fatigue, Durability 5.25 Explicit Analysis, Crash Analysis (Abaqus) **6. Testing of Farm Machinery (0-2-1)** 6.1 Introduction to testing of agricultural implements in actual field conditions. 6.2 Test codes for agricultural machines. 6.3 Testing of seeding machine 6.4 Testing of weeding machine 6.5 Testing of plant protection equipment, 6.6 Testing of crop harvester 6.7 Testing of threshing machines. 6.8 Testing of self-propelled combine harvester i.e. standard header, stripper header. 6.9 Testing of power tiller drawn tillage 6.10 Testing of tractor PTO shaft 6.11 Draw bar performance evaluation. 6.12 Testing of tractor wheels and hydraulic system 6.13 Testing of tractor systems cooling system, Brake system etc. **7. Product Development Project (0-0-8)** To develop a DIGITAL product and validate it and innovate using Catia/Simulia/Dymola Tools in Dassault 3 D experience. **Courseware link:** http://courseware.cutm.ac.in/courses/smart-farm-machinery/

2.	CUSW	Soil and Water Conservation through Watershed	28(4+11+13)

Courses Division (list all divisions):

1. Rainwater Harvesting and Artificial Recharge (CUSW2340) (1-2-0)
2. Integrated watershed management (CUSW2341) (2-1-0)
3. Sustainable Watershed (CUSW2342) (1-2-0)
4. R programming in watershed hydrology (CUSW2343) (0-2-1)
5. Modelling and Simulation of Watershed Processes (CUSW2344) (0-2-1)
6. Geo-spatial application in watershed management (CUSW2345) (0-2-1)
7. Industrial internship (CUSW2346) (0-0-10)

Domain Track Objectives:

- Build skills in collecting, analyzing, and critically evaluating watershed data and documents from multiple sources
- Apply hydrological modelling along with Geospatial application to manage the watershed
- Improving livelihoods in rainfed areas through integrated watershed management
- Pursue research and develop capabilities to handle multi-disciplinary field projects

Domain Track Course Outcomes:

- Analyzing and visualization of watershed data using R Programming
- Application of different hydrological models to simulate watershed process
- Application of rainwater harvesting in an integrated watershed management approach
- Application of geospatial tools and environment to achieve project objectives

Domain Syllabus:

1. Rainwater Harvesting and Artificial Recharge - CUSW2340 (1-2-0)

Theory

Rain water harvesting – definition and scope of rainwater harvesting; history of rainwater harvesting; need and importance of rainwater harvesting; components of rainwater harvesting; Hydrological aspects of water harvesting - hydrological cycle and water balance; hydrological characteristics; factors affecting runoff; runoff models suitable for water harvesting; Identification of areas suitable for water harvesting - parameters for identifying; suitable areas; methods of data acquisition; tools available; Different types of water harvesting structures - Negarim micro-catchments; contour bunds for trees; semi-circular bunds; contour ridges for crops; trapezoidal bunds; contour stone bunds; permeable rock dam; water spreading bunds; Runoff Inducement Methods; Roof water harvesting components and layout; Farm pond – types of farm ponds; embankment type; excavated or dugout ponds; site selection for dugout type farm ponds; Design of farm pond, Design of earthen embankment; Illustrate the importance of repair and maintenance of water harvesting structures; Artificial recharge techniques – direct and indirect methods;

Economic indicator - Net present value; benefit cost-ratio; internal rate of return; payback period.

Practice

Study of hydrological cycle and water balance; Studying runoff models suitable for water harvesting; Methods of data acquisition; Computation of trapezoidal bund requirement per hector; General design considerations for earth dam; Computing design or dependable catchment yield; Design of farm pond; Design of earthen embankment; Calculation of roof water harvesting and water harvesting potential; Design of storage tank capacity for roof-top rainwater harvesting; Analysis of causes of failure of earthen bund; Analysis of causes of failure of earthen embankment; Slices method of stability analysis; Foundation stability against shear; Calculation of roof water harvesting and water harvesting potential; Design of storage tank capacity for roof-top rainwater harvesting; Determination of phreatic line in earthen dam – graphical and analytical method; Case study for showing economic evaluation of recharge schemes; Operation and maintenance of water harvesting structures; Analyse the cost benefit of a water harvesting structures.

2. Integrated watershed management- CUSW2341 (2-1-0)

Theory:

Watershed definitions, Components, Coding of watershed, Familiarization with the watershed problems; Topographical survey, Morphometric analysis of watershed, Factors affecting watershed processes Delineation of watershed, Prioritization of watershed, Watershed response to land use; Storm water management, Flood management, drought management; Watershed development plan for rain-fed areas; Policies for IWM, Institutional activities on integrated watershed management; Tools for improved IWM practice; Review of Integrated Watershed Management Program in India.

Practice

Visualization of different geo-spatial tools used in IWM; Introduction to various open-source geo-spatial data repositories; Representation of earth features in GIS; Delineation of catchment area using Arc-GIS; Basic morphometric analysis of watershed; Preparation of Thiessen polygon to compute areal precipitation; Preparation of spatial maps of different watershed components; Environmental flow assessment; Identification of potential sites for conservation structure implementation; Field visit for working knowledge on different adaptive options on watershed management; Understanding of past successful IWM programs.

3. Sustainable Watershed- CUSW2342 (1-2-0)

Theory

History, development and national importance of watershed programs; Principles and objectives of watershed; Introduction to the concept of sustainable watershed management; Principles of sustainable watershed management; Natural resources management and different case Study; Hydrologic modelling for sustainable watershed management; Hydrologic modelling related case studies; Watershed health and sustainability; Water law and policy; Ecosystem services; Floods - causes of occurrence, flood classification - probable maximum flood, standard project flood, design flood; Flood control-history of flood control, structural and non-structural measures of flood control, storage and detention reservoirs, levees, channel improvement. Flood routing.

Practice

Hydrologic modelling for sustainable watershed management using GIS approach; Identification of recharge areas using remotely sensed data; Erosion, erodibility & sediment yield modelling; Reservoir sedimentation estimation using GIS and remote sensing; Introduction to HEC-HMS model; Simulation through HEC-HMS model; Practice on HEC-HMS model; Flood estimation-methods of estimation; flood frequency methods – log normal, Gumbel's extreme value; Flood routing related basic equations; Hydrologic storage routing method: Modified Pul's method; Hydrologic storage routing method: Goodrich method; Hydrologic channel routing: Muskingum equation; Introduction to 1D river modelling; Simulation of flood model; Overview of 2D modelling and difference between 1D and 2D flood modelling.

4. R programming in watershed hydrology- CUSW2343 (0-2-1)

Practice

Programming Language: basic definition and terms; Introduction to R programming; Basic syntax in R-programming; A first R session; Working with Data in R; Data type in R; R-Functions and R-strings; R-vector, R-Lists; R-Matrix, R array; R-factors, R-Dataframes; R – Packages, R – Csv Files and R – Excel File; R – Scatterplots, R – Line Graphs and R – Histograms; R – Boxplots, R – Bar Charts and R – Pie Charts; R – Linear Regression, R – Multiple Regression and R – Logistic Regression; R – Normal Distribution, R – Binomial Distribution; Creating Confidence Intervals, Performing t Tests; R – Poisson Regression, R – Analysis of Covariance and R – Time Series Analysis; R – Nonlinear Least Square and R – Chi Square Test; Nonparametric Tests in R; R- Simple Hypothesis Testing; R for Simulation; The "New" Statistics: Resampling and Bootstrapping; Making an R Package; R in hydrology: a review of recent developments; R-Packages for retrieving hydro-meteorological data; R-Packages for reading, manipulating, and cleaning the data; R-Packages for extracting driving data, spatial analysis, and cartography; R-Packages for hydrological statistics; R-Packages for static and dynamic hydrological data visualization.

5. Modelling and simulation of watershed processes- CUSW2344 (0-2-1)

Practice

Brief introduction on watershed processes, importance of modeling and simulation of watershed processes; Introduction and installation of SWAT model and overview of data requirements ; Watershed delineation, HRU analysis; Simulation through SWAT model (calibration); Simulation through SWAT model (validation); Introduction and installation of SPAW model and overview of data requirements; Simulation through SPAW model (calibration); Practice class for simulation with SWAT and SPAW; HEC-RAS model: Introduction and overview of model, installation; Simulation through HEC-RAS model; HBV model: Introduction and overview of model, installation; Simulation through HBV model; Practice class for simulation with HEC-RAS and HBV; Introduction to TOP model and installation; Simulation through TOP model; DSS-ET model: Introduction and overview; Installation, Simulation with DSS-ET model; Case studies with different hydrological models.

6. Geo-spatial application in watershed management- CUSW2345 (0-2-1)

Practice

Installation of Arc GIS; Downloading of maps and imageries from online repositories; Basic GIS operations in ARC GIS; Representation of earth features in GIS; Working with satellite imageries; Geo-referencing of satellite image; Preparation of contour map in ARC GIS; Preparation of slope and aspect map of watershed; Introduction to google earth; Google earth application as a ground truth tool; Supervise LULC classification; Un-supervise LULC classification; Preparation of drainage density map and stream ordering; Watershed delineation using DEM; Mapping of soil erosion; Identification of potential locations for groundwater recharge; River flow path analysis; Evapotranspiration mapping using MODIS product; Water budget analysis using ARC GIS.

Reference Books

1. Pourghasemi, H. R., & Gokceoglu, C. (Eds.). (2019). Spatial modeling in GIS and R for earth and environmental sciences. Elsevier.
2. Kennedy, M. D. (2013). Introducing geographic information systems with ARCGIS: a workbook approach to learning GIS. John Wiley & Sons.
3. Gonenc, I. E., Wolflin, J. P., & Russo, R. C. (Eds.). (2014). Sustainable Watershed Management. CRC Press.
4. Wani, S. P., Rockstrom, J., & Sahrawat, K. L. (2011). Integrated watershed management in rainfed agriculture. CRC Press.
5. Beheim, E., Rajwar, G. S., Haigh, M., & Krecek, J. (Eds.). (2012). Integrated watershed management: perspectives and problems. Springer Science & Business Media.

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<tr><td></td><td colspan="3">6. Mailund, T. (2017). Advanced Object-Oriented Programming in R: Statistical Programming for Data Science, Analysis and Finance. Apress.

Courseware link: http://courseware.cutm.ac.in/courses/soil-and-water-conservation-through-watershed/</td></tr>
<tr><td>3.</td><td>CUFP</td><td>Food Processing</td><td>28 (3-15-10)</td></tr>
<tr><td></td><td colspan="3">Course Divisions
7. Processing Technology of Cereals and Millets (1-2-0)
8. Processing Technology of Legumes and Oilseeds (1-2-0)
9. Processing Technology of Fruits, Vegetables, Spices and Condiments(1-2-0)
10. Product Development and Packaging Technologies (0-3-0)
11. Food Standards and Regulations and HACCP Systems (0-3-0)
12. Sensory Evaluation and Nutritional Labelling of Foods (0-3-0)
13. AELP Linked Project (0-0-11)

Domain Track Objectives:
• Impart an understanding of general process flow of various food products, physical principles of operation for various types of equipment and the impact of the processing on the physical, chemical and sensory properties of the food products
• Understand the concepts and principles of processing and packaging techniques and the effects of processing parameters on product safety and quality
• Gain insights into the scientific, regulatory, and consumer interests that interact in determining the safety of food

Domain Track Course Outcomes:
Upon completion students will be able to:
• Operate and maintain processing equipment
• Formulate and make processed food product
• Adopt hygienic and sanitation practices during product preparation
• Understand and develop HACCP plans based on the standards and regulations
• Perform sensory evaluation and develop nutrition labels for food products
• Domain Syllabus:
1. Processing Technology of Cereals and Millets (1-2-0)
Theory
General Introduction, Properties of cereals and millets, Paddy Processing, Parboiling of paddy, Drying, Wheat processing, Corn milling, Malting of cereals, Rice fortification methods, Food packaging and quality
Practice
Physical properties of cereals, Physical and frictional properties of cereals, Moisture content of grain, Parboiling and cooking quality of paddy, Preparation of puffed and flaked rice and sorghum. Estimation of milling qualities in a rice mill, Proximate analysis of cereal based products, Estimation of moisture content and drying time calculations</td></tr>
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2. Processing Technology of Legumes and Oilseeds (1-2-0)

Theory

General Introduction, Morphology, Pulse Milling, Pulse Processing, Oil seed Milling and problems in oil seed milling, Refining of oils

Practice

Estimation of physical properties of legumes and oilseeds, Determination of proximate composition of selected pulses and oilseeds, Preconditioning of pulses before milling, Laboratory milling of selected pulses and oilseeds and its quality evaluation, Laboratory refining of selected oils, Study of cooking quality of pulses

3.Processing Technology of Fruits, Vegetables, Spices and Condiments (1-2-0)

Theory

General Introduction, Primary processing and packaging, Canning, FSSAI specifications and food quality, Value added products, Spices and Condiments, Spice Board of India

Practice

Primary processing of selected fruits and vegetables, Estimation of TSS, pH, Acidity, and Ascorbic acid, Study of steps of Can making process, Processing of food using salt, high concentration of sugar, acidulants, and fermentation techniques, Drying of fruits and vegetables using freeze-drying, Adulteration test of spices

4. Product Develoment and Packaging Technologies (0-3-0)

Product design process, Product development process, Formulation and composition description, Process flow diagram, Process development, Packaging principles, Types of packaging - MAP, CAP, VP, Preparation and packaging of food products

5. Food Standards and Regulations and HACCP Systems (0-3-0)

Codex Alimentarius, FSSAI, ISO, SQF, GMP's, SOP's, SSOP's, FHP, HACCP Principles, APEDA, Spice Board

6. Sensory Evaluation and Nutritional Labelling of Products (0-3-0)

Sensory attributes of foods, Sensory evaluation methodology, Threshold measurements, Difference Tests, Descriptive analytical methods, Consumer tests, Nutritional labelling

7. Project (0-0-10)

- Formulate and Preparation of Products
- Develop HACCP plans for formulated product
- Identify standards and regulations for the food products
- Sensory evaluation of the developed products
- Label and develop appropriate packaging and storage methods

Suggested References

- Post-Harvest Technology of Cereals, Pulses and Oilseeds. A.Chakravarty
- Industrial Processing of Fruits and Vegetables. U.D. Chavan and J.V. Patil. 2013. AstralInternational Pvt. Ltd., New Delhi.
- Advances in Preservation and Processing Technologies of Fruits and Vegetables. S. Rajarathnam and R.S. Ramteke. 2011. New India Publishing Agency, New Delhi.
- Fruit & Vegetable Preservation: Principles and Practices. R.P. Srivastava and Sanjeev Kumar. 2002., 3rd Ed. International Book Distribution Co., Delhi.

	• Preservation of Fruits and Vegetables. Girdhari Lal, G.S. Siddappa and G.L. Tandon. 1959. ICAR, New Delhi. • Spices and Condiments. Pruthi, J.S., 1980. Academic Press, New York. • Methods for Developing New Food Products – An Instructional Guide. Fadi Aramouni, Kathryn Deschenes, 2015 • Food Packaging – Principles and Practice. Gordon L. Robertson. CRC Press, Taylor and Francis Group • Sensory Evaluation of Food – Principles and Practice, Harry T. Lawless and Hildegrade Heymann. **Courseware link:** http://courseware.cutm.ac.in/courses/food-processing/