COURSES SCHEME

&

SYLLABUS

FOR

B.E.

ELECTRICAL ENGINEERING

2015

Applicable from July 2015 to electrical engineering program
ENGINEERING DEPARTMENTS –COURSE SCHEME (ELE)

COURSES SCHEME & SYLLABUS FOR B.E. (ELECTRICAL ENGINEERING)

SEMESTER – I

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA003	MATHEMATICS-I	3	1	0	3.5
2	UTA007	COMPUTER PROGRAMMING-I	3	0	2	4.0
3	UPH004	APPLIED PHYSICS	3	1	2	4.5
4	UEE001	ELECTRICAL ENGINEERING	3	1	2	4.5
5	UHU003	PROFESSIONAL COMMUNICATION	2	0	2	3.0
6	UTA008	ENGINEERING DESIGN-I	2	4	0	4.0
		TOTAL	16	7	8	23.5

SEMESTER – II

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA004	MATHEMATICS-II	3	1	0	3.5
2	UTA009	COMPUTER PROGRAMMING-II	3	0	2	4.0
3	UES009	MECHANICS	2	1	2*	2.5
4	UEC001	ELECTRONIC ENGINEERING	3	1	2	4.5
5	UCB008	APPLIED CHEMISTRY	3	1	2	4.5
6	UTA010	ENGINEERING DESIGN-II (Catapult and more such projects) (6 Self Effort Hours)	1	0	2	5.0
		TOTAL	15	4	8	24.0

* EACH STUDENT WILL ATTEND ONE LAB SESSION OF TWO HOURS IN A SEMESTER FOR A BRIDGE PROJECT IN THIS COURSE (MECHANICS).

SEMESTER – III

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA031	OPTIMIZATION TECHNIQUES	3	1	0	3.5
2	UTA002	MANUFACTURING PROCESSES	2	0	3	3.5
3	UES010	SOLIDS AND STRUCTURES	3	1	2	4.5
4	UES011	THERMO-FLUIDS	3	1	2	4.5
5	UTA011	ENGINEERING DESIGN-III (Buggy and more such projects)(with 8 self effort hours)	2	0	4	8.0
6	UEE301	DIRECT CURRENT MACHINES AND TRANSFORMERS	3	1	2	4.5
		TOTAL	16	4	13	28.5

SEMESTER – IV

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA007	NUMERICAL ANALYSIS	3	1	2	4.5
2	UES012	ENGINEERING MATERIALS	3	1	2	4.5
3	UHU005	HUMANITIES FOR ENGINEERS	2	0	2	3.0
4	UEN002	ENERGY AND ENVIRONMENT	3	0	0	3.0
5	UEE505	ANALOG AND DIGITAL SYSTEMS	3	1	2	4.5
6	UEE405	NETWORK THEORY AND DESIGN (Project with 7 self effort hours)	3	1	2	8.0
		TOTAL	17	4	10	27.5

* The L T P of Department Specific subjects may vary for different branches but the weekly contact hours should not exceed 32. The design projects have higher number of credits to compensate for self effort hours each student is expected to put in.

SEMESTER – V

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEE401	ALTERNATING CURRENT MACHINES	3	1	2	4.5
2	UEE403	MEASUREMENT AND TRANSDUCERS	3	0	2	4.0
3	UEE404	TRANSMISSION AND DISTRIBUTION OF POWER	3	1	0	3.5
4	UEE507	ENGINEERING ELECTROMAGNETICS	3	1	0	3.5
5	UEE504	POWER ELECTRONICS	3	1	2	4.5
6	UEI404	DIGITAL SIGNAL PROCESSING FUNDAMENTALS	3	1	0	3.5
7	UTA012	INNOVATION AND ENTREPRENEURSHIP (with 5 self effort hours)	1	0	2	4.5
		TOTAL	19	5	8	28.0

SEMESTER – VI

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEI609	FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS	3	1	2	4.5
2	UEI501	CONTROL SYSTEMS	3	1	2	4.5
3	UEE605	POWER SYSTEM ANALYSIS AND STABILITY	3	1	2	4.5
4	UEE603	SWITCHGEAR AND PROTECTION	3	0	2	4.0
5	UEE801	ELECTRIC DRIVES	3	1	2	4.5
6	UEE	ELECTIVE-I	3	0	0	3.0
7	UEE693	CAPSTONE PROJECT (START)(with 4 self effort hours)	0	0	2	0.0
		TOTAL	18	4	12	25.0

SEMESTER – VII

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEE502	HIGH VOLTAGE ENGINEERING	3	0	2	4.0
2	UEE604	FLEXIBLE AC TRANSMISSION SYSTEMS	3	1	0	3.5
3	UEE702	INTELLIGENT TECHNIQUES IN ELECTRICAL ENGINEERING	3	0	2	4.0
4	UEE804	OPERATION AND CONTROL OF POWER SYSTEMS	3	1	2	4.5
5	-	ELECTIVE-II	3	1	0	3.5
6	UEE793	CAPSTONE PROJECT (COMPLETION) (with 8 self effort hours)	0	0	2	8.0
		TOTAL	15	3	8	27.5

SEMESTER – VIII

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEE891	PROJECT	–	–	–	20.0
OR						
ALTERNATE PROJECT SEMESTER						
1	UEE892	DESIGN PROJECT	–	–	–	13.0
2	UEE806	ALTERNATE SOURCES OF ENERGY	3	0	2	4.0
3	UEI805	ENVIRONMENTAL INSTRUMENTATION	3	0	0	3.0
		TOTAL	6	0	2	20
OR						
1	UEE893	START- UP SEMESTER	–	–	–	20.0

ELECTIVE-I

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEE631	HVDC TRANSMISSION SYSTEMS	3	0	0	3.0
2	UEE632	POWER GENERATION AND ECONOMICS	3	0	0	3.0
3	UEE633	GENERALIZED THEORY OF ELECTRICAL MACHINES	3	0	0	3.0

ELECTIVE-II

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UEE524	POWER QUALITY MONITORING AND CONDITIONING	3	1	0	3.5
2	UEE841	INDUSTRIAL ELECTRONICS	3	1	0	3.5
3	UEE521	ELECTRIC MACHINE DESIGN	3	1	0	3.5
4	UEE850	SMART GRID	3	1	0	3.5
5	UEI841	ADVANCED CONTROL SYSTEMS	3	1	0	3.5

TOTAL CREDITS: 204

Course Syllabi: UMA003 Mathematics - I (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UMA003 Mathematics – I

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.*
   - *Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.*
   - *Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).*
   - *Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).*

   a. Other supplemental materials
   - *Nil*

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Applications of Derivatives: Mean value theorems and their geometrical interpretation, Cartesian graphing using first and second order derivatives, Asymptotes and dominant terms, Graphing of polar curves, Applied minimum and maximum problems.
   Sequences and Series: Introduction to sequences and Infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence and conditional convergence.
   Series Expansions: Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.
   Partial Differentiation: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives.
   Multiple Integrals: Change of order of integration, Change of variables, Applications of multiple integrals.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Apply the knowledge of calculus to plot graphs of functions and solve the problem of maxima and minima.
   - Determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
   - Evaluate multiple integrals and their applications to engineering problems.
   - Examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima.
   - Analyze some mathematical problems encountered in engineering applications.

6. **Brief list of topics to be covered**
   - Applications of Derivatives
   - Sequences and Series
   - Series Expansions
   - Partial Differentiation

- Multiple Integrals

Course Syllabi: UTA007: Computer Programming-I (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UTA007; Computer Programming-I

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *"Brain W. Kernighan, Dennis M. Rithchie", The C Programming Language (2nd Edition), Prentice Hall, 1988.*
   - *"Ajay Mittal", Programming in C-A Practical Approach, Pearson, 2010.*
   - *"Reema Thareja", Computer Fundamentals and Programming in C, Oxford University Press, 2012.*
   - *"Zed. A. Shaw", Learn C the Hard Way, Pearson, 2015.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Computers Fundamentals: Classification of Computers, Application of Computers, Basic organization of computer, Input and Output Devices, Binary Number System, Computer memory, Computer Software.
   Algorithms and Programming Languages: Algorithm, Flowcharts, Pseudocode, Generation of Programming Languages.
   C Language: Structure of C Program, Life Cycle of Program from Source code to Executable, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types in C, variables, constants, input/output statements in C, Operators, type conversion and type casting. Conditional branching statements, Iterative statements, Nested loops, break and continue statements.
   Functions: Declaration, Definition, Call and return, Call by value, Call by reference, showcase stack usage with help of debugger, Scope of variables, Storage classes, Recursive functions, Recursion vs Iteration.
   Arrays, Strings and Pointers: One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: traversal, insertion, deletion, merging and searching, Inter-function communication via arrays: passing a row, passing the entire array, matrices. Reading, writing and manipulating Strings, Understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers.
   Linear and Non-Linear Data Structures: Linked lists, Stacks and Queues.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Comprehend concepts related to computer hardware and software, draw flowcharts and write algorithm/pseudocode.
   - Write, compile and debug programs in C language, use different data types, operators and console I/O function in a computer program.
   - Design programs involving decision control statements, loop control statements, case control structures, arrays, strings, pointers, functions and implement the dynamics of

memory by the use of pointers.

- Comprehend the concepts of linear and Non-Linear data structures by implementing linked lists, stacks and queues.

6. Brief list of topics to be covered

- Functions
- Arrays
- Strings
- Pointers

Course Syllabi: UPH004: Applied Physics (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UPH004: Applied Physics

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6th ed.*
- *Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3rd ed.*
- *Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4th ed.*
- *Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4th ed.*
- *Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)1st ed.*
- *Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall™ (2008) 3rd ed.*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Oscillations and Waves: Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; ***Acoustics:*** Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; ***Ultrasonics:*** Production and Detection of Ultrasonic waves, Applications - green energy, sound signalling, dispersion of fog, remote sensing, Car's airbag sensor.
Electromagnetic Waves: Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.
Optics: ***Interference:*** Parallel and wedge-shape thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. ***Diffraction:*** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. ***Polarization:*** Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows. ***Lasers:*** Basic concepts, Laser properties, Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.
Quantum Mechanics: Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunnelling effect (Qualitative idea), Application - Quantum computing.

Laboratory Work:

- Determination of damping effect on oscillatory motion due to various media.
- Determination of velocity of ultrasonic waves in liquids by stationary wave method.
- Determination of wavelength of sodium light using Newton's rings method.
- Determination of dispersive power of sodium-D lines using diffraction grating.
- Determination of specific rotation of cane sugar solution.

- Study and proof of Malus' law in polarization.
- Determination of beam divergence and beam intensity of a given laser.
- Determination of displacement and conducting currents through a dielectric.
- Determination of Planck's constant

5. Specific goals for the course

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

- Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.
- Use Maxwell's equations to describe propagation of EM waves in a medium.
- Demonstrate interference, diffraction and polarization of light.
- Explain the working principle of Lasers.
- Use the concept of wave function to find probability of a particle confined in a box.

6. Brief list of topics to be covered

- Oscillations and Waves
- *Ultrasonics*
- Electromagnetic Waves
- Optics, *Polarization, Lasers*
- Quantum Mechanics

Course Syllabi: UEE001: Electrical Engineering (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE001; Electrical Engineering

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, PHI (2008).*
- *Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).*
- *Naidu, M.S. and Kamashaiah, S., Introduction to Electrical Engineering, Tata McGraw Hill (2007).*
- *Chakraborti, A., Basic Electrical Engineering, Tata McGraw–Hill (2008).*
- *Del Toro, V., Electrical Engineering Fundamentals, Prentice–Hall of India Private Limited (2004)*

a. Other supplemental materials

- Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

DC Circuits: Kirchhoff's Voltage and Current Laws; Power Dissipation; Voltage Source and Current Source; Mesh and Nodal Analysis; Star-Delta Transformation; Superposition Theorem; Thevenin's Theorem; Norton's Theorem; Maximum Power Transfer Theorem; Millman's Theorem and Reciprocity Theorem; Transient Response of Series RL and RC Circuits.

Steady state analysis of DC Circuits: The Ideal Capacitor, Permittivity; The Multi-Plate Capacitor, Variable Capacitor; Capacitor Charging and Discharging, Current-Voltage Relationship, Time-Constant, Rise-Time, Fall-Time; Inductor Energisation and De-Energisation, Inductance Current-Voltage Relationship, Time-Constant; Transient Response of RL, RC and RLC Circuits.

AC Circuits: Sinusoidal sources, RC, RL and RLC circuits, Concept of Phasors, Phasor representation of circuit elements, Complex notation representation, Single phase AC Series and parallel circuits, Power dissipation in AC circuits, Power factor correction, Resonance in Series and Parallel circuits, Balanced and unbalanced 3-phase circuit - voltage, current and power relations, 3-phase power measurement, Comparison of single phase and three phase supply systems.

Electromagnetism: Electromagnetic induction, Dot convention, Equivalent inductance, Analysis of Magnetic circuits, AC excitation of magnetic circuit, Iron losses, Fringing and stacking applications: solenoids and relays.

Single Phase Transformers: Constructional features of transformer, operating principle and applications, equivalent circuit, phasor analysis and calculation of performance indices.

Motors and Generators: DC motor operating principle, construction, energy transfer, speed-torque relationship, conversion efficiency, applications, DC generator operating principle, reversal of energy transfer, emf and speed relationship, applications.

Laboratory Work: Network laws and theorems, Measurement of R,L,C parameters, A.C. series and parallel circuits, Measurement of power in 3 phase circuits, Reactance calculation of variable reactance choke coil, Open circuit and Short circuit tests on single phase transformer, Starting of rotating machines.

5. Specific goals for the course

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

- Apply networks laws and theorems to solve electric circuits.
- Analyze transient and steady state response of DC circuits.
- Signify AC quantities through phasor and compute AC system behaviour during steady state.
- Explain and analyse the behaviour of transformer.
- Elucidate the principle and characteristics of DC motor and DC generator**.**

6. Brief list of topics to be covered

- DC Network
- DC Tansients
- AC Circuits
- Electromagnetism
- Single Phase Transformers
- DC Motors and Generators

Course Syllabi: UHU003: Professional Communication (L : T : P :: 2 : 0 : 2)

1. **Course number and name**: UHU003: Professional Communication

2. **Credits and contact hours**: 3.0 and 4

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Lesikar R.V and Flately M.E., Basic Business Communication Skills for the Empowering the Internet Generation. Tata McGraw Hill. New Delhi (2006).*
- *Raman,M& Sharma, S.,Technical Communication Principles and Practice, Oxford University Press New Delhi.(2011).*
- *Mukherjee H.S.,Business Communication-Connecting at Work,Oxford University Press New Delhi, (2013).*
- *Butterfield, Jeff.,Soft Skills for everyone,Cengage Learning New Delhi,(2013).*
- *Robbins, S.P., &Hunsaker, P.L.,Training in Interpersonal Skills,Prentice Hall of India New Delhi,(2008).*
- *DiSianza,J.J&Legge,N.J.,Business and PrfofessionalCommunication,Pearson Education India New Delhi,(2009).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Effective Communication: Meaning, Barriers, Types of Communication and Essentials Interpersonal Communication Skills.

Effective Spoken Communication: Understanding essentials of spoken communication, Public speaking, Discussion techniques, Presentation strategies.

Effective Professional and Technical writing: Paragraph development, Forms of writing, Abstraction and Summarization of a text; Technicalities of letter writing, internal and external organizational communication. Technical reports, proposals and papers.

Effective Non-verbal communication: Knowledge and adoption of the right non-verbal cues of body language, interpretation of the body language in professional context. Understanding Proxemics and other forms of Non-verbal communication.

Communicating for Employment: Designing Effective Job application letter and resumes; Success strategies for Group discussions and Interviews.

Communication Networks in organizations: Types, barriers and overcoming the barriers.

Laboratory Work:

- Needs-assessment of spoken and written communication and feedback.
- Training for Group Discussions through simulations and role plays.
- Training for effective presentations.
- Project based team presentations.
- Proposals and papers-review and suggestions.

Minor Project (if any):

Team projects on technical report writing and presentations.

5. **Specific goals for the course**

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

   - Understand and appreciate the need of communication training.
   - Use different strategies of effective communication.
   - Select the most appropriate mode of communication for a given situation.
   - Speak assertively and effectively.
   - Correspond effectively through different modes of written communication.
   - Write effective reports, proposals and papers.
   - Present himself/ herself professionally through effective resumes and interviews.

6. **Brief list of topics to be covered**

   - Effective Communication
   - Effective Spoken Communication
   - Effective Professional and Technical Writing
   - Effective Non-Verbal Communication
   - Communicating for Employment
   - Communication Networks in Organizations

Course Syllabi: UTA008: Engineering Design-I (L : T : P :: 2 : 4 : 0)

1. **Course number and name**: UTA008; Engineering Design-I

2. **Credits and contact hours**: 4.0 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Jolhe, D.A., Engineering Drawing, Tata McGraw Hill, 2008*
     Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics, Van Nostrand Reinhold *(UK), 1986*
   - *Gill, P.S., Geometrical Drawings, S.K. Kataria & Sons, Delhi (2008).*
   - *Gill, P.S., Machine Drawings, S.K. Kataria & Sons, Delhi (2013).*
   - *Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).*
   - *French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company, New Delhi (1986).*
     Rowan, J. and Sidwell , E. H., Graphics for Engineers, Edward Arnold, London (1968).

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

   Engineering Drawing

   1. Introduction
   2. Orthographic Projection: First angle and third angle projection system
   3. Isometric Projections
   4. Auxiliary Projections
   5. Perspective Projections
   6. Introduction to Mechanical Drawing
   7. Sketching Engineering Objects
   8. Sections, Dimensions and Tolerances

   AutoCAD

   1. Management of screen menus commands
   2. Introduction to drawing entities
   3. Co-ordinate systems: Cartesian, polar and relative coordinates
   4. Drawing limits, units of measurement and scale
   5. Layering: organizing and maintaining the integrity of drawings
   6. Design of prototype drawings as templates.
   7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
   8. Dimensioning: use of annotations, dimension types, properties and placement, adding text to drawing

   Micro Projects /Assignments:

   1. Completing the views - Identification and drawing of missing lines in the projection of objects

2. Missing Views – using two views to draw the projection of the object in the third view, primarily restricting to Elevation, Plan and Profile views
3. Projects related to orthographic and isometric projections
    a. Using wax blocks or soap bars to develop three dimensional object from given orthographic projections
    b. Using wax blocks or soap bars to develop three dimensional object, section it and color the section
    c. Use of AUTOCAD as a complementary tool for drawing the projections of the objects created in (1) and (2).
4. Develop the lateral surface of different objects involving individual or a combination of solids like Prism, Cone, Pyramid, Cylinder, Sphere etc.
5. To draw the detailed and assembly drawings of simple engineering objects/systems with due sectioning (where ever required) along with bill of materials.
   e.g. Rivet joints, simple bearing, wooden joints, Two plates connected with nut and bolt etc.

5. Specific goals for the course

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

- Creatively comprehend geometrical details of common engineering objects.
- Draw dimensioned orthographic and isometric projections of simple engineering objects.
- Interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism.
- Create the engineering drawings for simple engineering objects using autocad.
- Manage screen menus and commands using autocad.
- Operate data entry modes and define drawings geometrically in terms of cartesian, polar and relative coordinates in autocad.
- Create and edit drawings making selections of objects, discriminating by layering and using entities, object snap modes, editing commands, angles and displacements using autocad.

6. Brief list of topics to be covered

- Orthographic Projection: First angle and third angle projection system
- Isometric Projections
- Auxiliary Projections
- Perspective Projections

Course Syllabi: UMA004 Mathematics - II (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UMA004 Mathematics - II

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).*
   - *Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).*
   - *Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8^{th} ed.*
   - *Jain, R.K. and Iyenger, S.R.K , Advanced Engineering Mathematics, Narosa Publishing House(2011), 11^{th} ed.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

   Ordinary Differential Equations: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

   Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

   Fourier Series: Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation

5. **Specific goals for the course**

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

   - Solve the differential equations of first and second order and basic application problems described by these equations.
   - Find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
   - Find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
   - Solve systems of linear equations by using elementary row operations.
   - Identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the eigen values and eigen vectors.

6. **Brief list of topics to be covered**
    - Linear Algebra
    - Ordinary Differential Equations
    - Laplace Transform
    - Fourier Series

Course Syllabi: UTA009 Computer Programming - II (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UTA009 Computer Programming- II

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *"Balaguruswamy", Object Oriented Programming with C++ 6th Edition, Tata Mcgraw Hill, 2013.*
   - *"Bruce Eckel", Thinking in C++, Prentice-Hall of India Pvt. Ltd, 2000.*
   - *"Joyce Farrell", Object Oriented Programming Using C++ 4th Edition, Cengage Learning, 2013.*
   - *https://msdn.microsoft.com/en-s/library/windows/desktop/ff381399(v=vs.85).aspx*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Object Oriented Programming with C++: Class declaration, creating objects, accessing objects members, nested member functions, memory allocation for class, objects, static data members and functions. Array of objects, dynamic memory allocation, this pointer, nested classes, friend functions, constructors and destructors, constructor overloading, copy constructors, operator overloading and type conversions.
   Inheritance and Polymorphism: Single inheritance, multi-level inheritance, multiple inheritance, runtime polymorphism, virtual constructors and destructors.
   File handling: Stream in C++, Files modes, File pointer and manipulators, type of files, accepting command line arguments.
   Templates and Exception Handling: Use of templates, function templates, class templates, handling exceptions.
   Introduction to Windows Programming in C++: Writing program for Windows, using COM in Windows Program, Windows Graphics, User Input
   Laboratory work: to implement Programs for various kinds of programming constructs in C++ Language.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Write, compile and debug programs in C++, use different data types, operators and I/O function in a computer program.
   - Comprehend the concepts of classes, objects and apply basics of object oriented programming, polymorphism and inheritance.
   - Demonstrate use of file handling.
   - Demonstrate use of templates and exception handling.
   - Demonstrate use of windows programming concepts using C++.

6. **Brief list of topics to be covered**
   - Class

- Object
- Inheritance
- Polymorphism
- File handling
- Exception handling

Course Syllabi: UES009 Mechanics (L : T : P :: 2 : 1 : 0)

1. **Course number and name**: UES009 Mechanics

2. **Credits and contact hours**: 2.5 and 3

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Shames, I. H. Engineering Mechanics: Dynamics, Pearson Education India (2002).*
   - *Beer, Johnston, Clausen and Staab, Vector Mechanics for Engineers, Dynamics, McGraw-Hill Higher Education (2003).*
   - *Hibler, T.A., Engineering Mechanics: Statics and Dynamics, Prentice Hall (2012).*
   - *Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill Education Private Limited (2000).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

   Review of Newton's law of motion and vector algebra
   Equilibrium of bodies: Free-body diagrams, conditions of equilibrium, torque due to a force, statical determinacy.
   Plane trusses*:* Forces in members of a truss by method of joints and method of sections.
   Friction: Sliding, belt, screw and rolling.
   Properties of plane surfaces: First moment of area, centroid, second moment of area etc.
   Virtual work: Principle of virtual work, calculation of virtual displacement and virtual work.
   Work and energy: Work and energy, work-energy theorem, principle of conservation of energy, collisions, principles of momentum etc.
   Dynamics of Rigid Bodies: Newton's Laws, D'Alembert's Principle, Energy Principles.
   Experimental project assignment/ Micro project: Students in groups of 4/5 will do project on
   Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

5. **Specific goals for the course**
   After the completion of the course, the students will be able to:
   - Determine resultants in plane force systems.
   - Identify and quantify all forces associated with a static framework.
   - Solve problems in kinematic and dynamic systems.

6. **Brief list of topics to be covered**
   - Plane trusses
   - Friction
   - Virtual work
   - Work and energy

- Dynamics of rigid bodies

Course Syllabi: UEC001 Electronic Engineering (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEC001 Electronic Engineering

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall, 2013.*
- *Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2007.*
- *Donald D Givone, Digital Principles and Design, McGraw-Hill, 2003.*
- *John F Wakerly, Digital Design: Principles and Practices, Pearson, (2000).*
- *N Storey, Electronics: a Systems Approach, Pearson, Prentice Hall, (2009).*
- *Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).*
- *M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall, 2013.*
- *Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2007.*
- *Donald D Givone, Digital Principles and Design, McGraw-Hill, 2003.*
- *John F Wakerly, Digital Design: Principles and Practices, Pearson, (2000).*
- *N Storey, Electronics: a Systems Approach, Pearson, Prentice Hall, (2009).*
    1. *Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Semiconductor Devices: P-N junction diode: Ideal diode, V-I characteristics of diode, Diode small signal model, Diode switching characteristics, Zener diode

Electronics Devices and Circuits: P-N Diode as a rectifier, Clipper and clamper, Operation of Bipolar Junction Transistor and Transistor Biasing, CB, CE, CC (Relationship between α, β, γ) circuit configuration Input-output characteristics, Equivalent circuit of ideal and real amplifiers, Low frequency response of amplifiers, Introduction to Field Effect Transistor and its characteristics

Operational Amplifier Circuits: The ideal operational amplifier, the inverting, non-inverting amplifiers, Op-Amp Characteristics, Frequency response of op-amp, Application of op-amp

Digital Systems and Binary Numbers: Introduction to Digital signals and systems, Number systems, Positive and negative representation of numbers, Binary arithmetic, Definitions and basic theorems of boolean Algebra**,** Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, AND, OR, NOT and Universal Gate, Minimization of logic functions, Karnaugh maps.

Combinational and Sequential Logic: Code converters, multiplexors, decoders, Addition circuits and priority encoder,Master-slave and edge-triggered flip-flops,Synchronous and Asynchronous counters, Registers

Logic families: N and P channel MOS transistors, CMOS inverter, NAND and NOR gates, General CMOS Logic, TTL and CMOS logic families, and their interfacing.

Laboratory Work:

Familiarization of CRO and Electronic Components, Diodes characteristics Input-Output and Switching characteristics, BJT and MOSFET Characteristics, Zener diode as voltage regulator, Transistorized Series voltage regulator. Half and Full wave Rectifiers with and without filter circuit, Half and full adder circuit implementation, Decoder, DMUX and MUX, Binary/BCD up/down counters.

5. **Specific goals for the course**

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

- Demonstrate the use of semiconductor diodes in various applications.
- Discuss and explain the working of transistors and Operational Amplifiers, their configurations and applications.
- Recognize and apply the number systems and Boolean Algebra.
- Reduce Boolean Expressions and implement them with Logic Gates.
- Analyze, design and Implement combinational and sequential circuits.
- Analyze and differentiate logic families, TTL and CMOS.

6. **Brief list of topics to be covered**

- Semiconductor devices
- Transistor
- FET
- Op-amp
- Digital circuits
- Sequential circuits

Course Syllabi: UCB008: Applied Chemistry (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UCB008: Applied Chemistry

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012) 1st ed.*
- *Jain, P.C. and Jain, M. Engineering Chemistry, DhanpatRai Publishing Co. (2005) 15th ed.*
- *Puri, B.R., Sharma and L.R., Pathania, M.S. Principles of Physical Chemistry, Vishal Publishing Co. (2008).*
- *Brown, Holme, Chemistry for engineering students, Thompson, 1st ed.*
- *Shulz, M.J. Engineering Chemistry, Cengage Learnings, (2007) 1st ed.*

a. *Other supplemental materials*

- *Nil*

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Atomic Structure and Bonding: Chemical change; elements, compounds and mixtures, Atomic structure, dual nature of electron, concept of atomic orbitals, Pauli`s Exclusion principle, Concept of chemical bonding: covalent, ionic, metallic, hydrogen bond, Vander Waal`s, Hybridization and shapes of molecule, electronic structure and periodic table.

Chemical Equilibrium: Law of mass action, Factors that influence the position of equilibrium. Ionic equilibria: ionic equilibria in aqueous solutions; strong and weak acids and bases; buffer solution and indicators.

Electrochemistry: Migration of ions, Transference number, Specific, Equivalent and Molar Conductivity of electrolytic solutions, Conductometric titrations, Electrode potential and types of electrodes, Introduction to galvanic and concentration cells, Liquid junction potential.

Colligative Properties of Dilute Solutions: Depression of freezing point and elevation of boiling point.

Phase Rule: States of matter, Phase, Component and Degree of freedom, Gibbs phase rule, One component and two component systems.

Water Treatment and Analysis: Hardness and alkalinity of water: Units and determination, External and internal method of Softening of water: Lime-soda Process, Ion exchange process, Desalination of brackish water.

Fuels: Classification of fuels, Calorific value, Cetane and Octane number, fuel quality, Comparison of solid liquid and gaseous fuel, properties of fuel, alternative fuels: Biofuels, Power alcohol, Synthetic petrol.

Application of Atomic and Molecular Spectroscopic Methods: Structure determination of certain model compounds of industrial importance.

Assignments based on working and applications of advanced instruments will be given in the tutorial class.

Laboratory Work

Electrochemical measurements: Experiments involving use of pH meter, conductivity meter, potentiometer.

Acid and Bases: Determination of mixture of bases

Spectroscopic techniques: Colorimeter, UV-Vis spectrophotometer.
Kinetics: Kinetics of oxidation of iodine ion by peroxydisulphate ion.
Thermochemistry: Cloud point and pour point determination
Water and its treatment: Determination of hardness, alkalinity, chloride, chromium, iron and copper in aqueous medium.

5. **Specific goals for the course**

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

- Analyse trends in periodic table with electronic and atomic structure.
- Interpret phase diagrams of pure and binary substances.
- Demonstrate the working of electrodes and their applications.
- Calculate various parameters defining water and fuel quality.
- Identify the various functional groups through IR spectra.
- Carry out basic experimental procedure and to emphasize need for safety and safety procedure in laboratory.

6. **Brief list of topics to be covered**

- Atomic Structure and Bonding
- Chemical Equilibrium
- Electrochemistry
- Colligative Properties of Dilute Solutions
- Phase Rule
- Water Treatment and Analysis
- Fuels

Course Syllabi: UTA010 Engineering Design-II (L : T : P :: 1 : 0 : 2)

1. **Course number and name**: UTA0101 Engineering Design-II

2. **Credits and contact hours**: 3 and 5.0

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Michael McRoberts, Beginning Arduino, Technology in action publications.*
   - *Alan G. Smith, Introduction to Arduino: a piece of cake, CreateSpace Independent Publishing Platform (2011)*

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

Breakup of lecture details to be taken up by MED:

Lec No.	Topic	Contents
Lec 1	Introduction	The Mangonel Project History.
Lec 2	CDIO	Conceive Design Implement and Operate.
Lec 3	Manufacturing	Manufacturing and assembling the Mangonel.
Lec 4		
Lec 5	Materials	How to choose the right material
Lec 6	Modelling	The role of modelling in Engineering Design
Lec 7	Structures	Why things fail?
Lec 8	Dynamics	Dynamics of the Mangonel
Lec 9	Structures	Designing against structural failure
Lec 10	Kinematics/Software Modelling	Simulation as an Analysis Tool in Engineering Design

Breakup of lecture details to be taken up by ECED:

Lec No.	Topic	Contents
Lec 11-15	Digital Electronics	Prototype, Architecture, Using the Integrated Development Environment (IDE) to Prepare an Arduino Sketch, Structuring an Arduino Program, Using Simple Primitive Types (Variables), Simple programming examples. Definition of a sensor and actuator.

Laboratory Work:
Associated Laboratory/Project Programme:

Laboratory Title	Code
Dynamics of Mangonel - No Drag	L1

Dynamics of Mangonel - with Drag	L2
Design against failure under static actions	L3
Design against failure under dynamic actions	L4
Simulation	L5
Manufacturing components of the Mangonel	L6
Manufacturing components of the Mangonel	L7
Manufacturing components of the Mangonel	L8
Manufacturing components of the Mangonel	L9
Assembly of Mangonel	L10
Spring Test of Mangonel	L11
Distance Test of Mangonel	L12
Speed Test of Mangonel	L13
Mangonel redesign for competition	L14
Competition	L15

5. **Specific goals for the course**

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

   - Model trajectories of masses with and without aerodynamic drag.
   - Develop a software tool to allow trajectories be optimized.
   - Analyse the static and dynamic stresses of elements of an engineering mechanism.
   - Optimally design structural elements of an engineering mechanism.
   - Perform a test to acquire an engineering material property.
   - Develop and test software code to process sensor data.
   - Design and construct and test an electronic hardware solution to process sensor data.
   - Construct a roman catapult “mangonel” using tools, materials and assembly instructions.
   - Operate and evaluate the “mangonel” for functional and structural performance.
   - Validate theoretical models by comparison with experiments.
   - Integrate skills to innovatively redesign an element of the “mangonel”.
   - Participate and cooperate in a team.

Course Syllabi: UMA031: Optimization Techniques (L : T : P :: 3 : 1 : 0)

1. Course number and name: UMA031 Optimization Techniques

2. Credits and contact hours: 3.5 and 4

3. Text book, title, author, and year

Text Books / Reference Books

- *Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).*
- *Taha H.A., Operations Research-An Introduction, PHI (2007).*
- *Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)*
- *Bazaarra Mokhtar S., Jarvis John J. and Shirali Hanif D., Linear Programming and Network flows, John Wiley and Sons (1990)*
- *Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).*

a. Other supplemental materials

- Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Scope of Operations Research: Introduction to linear and non-linear programming formulation of different models.

Linear Programming: Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.

Integer Programming: Branch and bound technique.

Transportation and Assignment Problem: Initial basic feasible solutions of balanced and unbalanced transportation/assignment problems, Optimal solutions.

Project Management: Construction of networks, Network computations, Floats (free floats and total floats), Critical path method (CPM), Crashing.

Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solution by linear programming.

5. Specific goals for the course

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

- Formulate and solve linear programming problems.
- Solve the transportation and assignment problems
- Solve the project management problems using cpm.
- Solve two person zero-sum games.

6. Brief list of topics to be covered

- Scope of Operations Research
- Linear Programming
- Integer Programming
- Transportation and Assignment Problem
- Project Management
- Game Theory

Course Syllabi: UTA002: Manufacturing Processes (L : T : P :: 2 : 0 : 3)

1. Course number and name: UTA002 Manufacturing Processes

2. Credits and contact hours: 3.5 and 5

3. Text book, title, author, and year

Text Books / Reference Books

- *Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).*
- *Taha H.A., Operations Research-An Introduction, PHI (2007).*
- *Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)*
- *BazaarraMokhtar S., Jarvis John J. and ShiraliHanif D., Linear Programming and Network flows, John Wiley and Sons (1990)*
- *Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to multi-point machining processes – milling, drilling and grinding, Tool Life, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

Metal Casting: Principles of metal casting, Introduction to sand casting, Requisites of a sound casting, Permanent mold casting processes.

Metal Forming: Forging, Rolling, Drawing, Extrusion, Sheet Metal operations.

Joining Processes: Electric arc, Resistance welding, Soldering, Brazing.

Laboratory Work:

Relevant shop floor exercises involving practices in Sand casting, Machining, Welding, Sheet metal fabrication techniques, CNC turning and milling exercises, Experiments on basic engineering metrology and measurements to include measurements for circularity, ovality, linear dimensions, profiles, radius, angular measurements, measurement of threads, surface roughness.

Basic knowledge and derivations related to above measurements, uncertainties, statistical approaches to estimate uncertainties, Line fitting, static and dynamic characteristics of instruments will be discussed in laboratory classes.

5. Specific goals for the course

After the completion of this module, students will be able to:

- Develop simple CNC code, and use it to produce components while working in groups.
- Analyse various machining processes and calculate relevant quantities such as velocities, forces.
- Recognise cutting tool wear and identify possible causes and solutions.
- Understand the basic principle of bulk and sheet metal forming operations for analysis of forces.
- Analyse various shearing operations for tooling design.
- Apply the knowledge of metal casting for different requirements.
- Analyse and understand the requirements to achieve sound welded joint while welding different similar and dissimilar engineering materials.

6. Brief list of topics to be covered

- Machining process
- Metal casting
- Metal forming

Course Syllabi: UES010 : Solids and Structures (L : T : P :: 3 : 1 : 2)

1. Course number and name: UES010 Solids and Structures

2. Credits and contact hours: 4.5 and 6

3. Text book, title, author, and year

Text Books / Reference Books

- *Popov, E.P. and Balan, T.A., Engineering Mechanics of Solids, Prentice Hall of India (2012).*
- *Singh, D.K., Mechanics of Solids, Pearson Education (2008).*
- *Shames, I. H. and Pitarresi, J. M., Solid Mechanics, Prentice Hall of India (1996).*
- *Crandall, S.H., Dahl, N.C. and Lardner, T.J., An Introduction to Mechanics of Solids, McGraw Hill International, Tokyo(1969).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Elastic Plastic Behavior

Axial Stress and Strain: Concept of stress, strain, elasticity and plasticity; one-dimensional stress-strain relationships; Young's modulus of elasticity, shear modulus and Poisson's ratio; two-dimensional elasticity; isotropic and homogeneous materials; ductile and brittle materials; statically determinate and indeterminate problems, compound and composite bars; thermal stresses. Torsion of shafts; buckling of struts, concept of factor of safety.

Shear Force and Bending Moment Diagrams: Types of load on beams, classification of beams; axial, shear force and bending moment diagrams: simply supported, overhung and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment, equation of condition, load function equation, qualitative analysis for two-dimensional frames.

Bending & Shear Stresses in beams: Derivation of flexural formula for straight beams, concept of second moment of area, bending stress calculation for beams of simple and built up sections, Flitched beams. Shear stress formula for beams, shear stress distribution in beams

Transformation of Stress and Strain: Transformation equations for plane stress and plane strain, Mohr's stress circle, relation between elastic constants, strain measurements, strain rosettes.

Deformations: Governing differential equation for deflection of straight beams having constant flexural rigidity, double integration and Macaulay's methods for slopes and deflection, unit load method for deflection of trusses

Laboratory Work

Experimental Project Assignment: Students in groups of 4/5 will do projects:

1. Calculation of tensile strength using UTM.
2. Buckling of struts.
3. Experimental verification of Theory of bending (calculation of bending stress and deflections at various points in the beam theoretically and verifying the same experimentally) and indirect evaluation of the modulus of elasticity.

4. Torsion: Study the behavior of circular shafts under torsion and analysis of failure and indirect evaluation of the modulus of rigidity.

Micro Project:
Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

5. **Specific goals for the course**
After completion of this course, the students will be able to:
   - Evaluate axial stresses and strains in various determinate and indeterminate structural systems.
   - Draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads.
   - Calculate load carrying capacity of columns and struts and their buckling strength.
   - Evaluate various kinds of stresses (axial, bending, torsional and shearing) in various structural elements due to different type of external loads.
   - Determine deformations and deflections in various kinds of beams and trusses.

6. **Brief list of topics to be covered**
   - Axial stress and strain
   - Shear force
   - Bending moment
   - Bending and shear stress in beams

Course Syllabi: UES011 : Thermo Fluids (L : T : P :: 3 : 1 : 2)

1. Course number and name: UES011 Thermo Fluids

2. Credits and contact hours: 4.5 and 6

3. Text book, title, author, and year

Text Books / Reference Books

- *Kumar, D. S, Fluid Mechanics and Fluid Power Engineering, S. K. Kataria (2009)*
- *Cengel and Boles, Thermodynamics: an Engineering Approach, McGraw-Hill (2011)*
- *Jain, A. K. , Fluid Mechanics: including Hydraulic Machines, Khanna Publishers (2003)*
- *Rao, Y.V. C, An Introduction to Thermodynamics, Universities Press (2004)*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Fluid Mechanics

Introduction: Definition of a fluid and its properties

Hydrostatics: Measurement of pressure, thrust on submerged surfaces

Principles of Fluid Motion: Description of fluid flow; continuity equation; Euler and Bernoulli equations; Pitot total head and static tubes, venturi-meter, orifice-meter, rotameter; Momentum equation and its applications

Pipe Flow: Fully developed flow; laminar pipe flow; turbulent pipe flow, major and minor losses; Hydraulic gradient line (HGL) and total energy line (TEL)

Boundary Layer: Boundary layer profile; displacement, momentum and energy thickness

Thermodynamics

Introduction: Properties of matter, the state postulate, energy, processes and thermodynamic systems;

Properties of Pure Substances: property tables, property diagrams, phase change, equations of state (ideal gas);

Energy: Energy transfer by heat, work and mass;

First Law of Thermodynamics: Closed system, open system, steady-flow engineering devices;

Second Law of Thermodynamics: Statements of the Second Law, heat engines, refrigeration devices, reversible versus irreversible processes, the Carnot cycle.

Laboratory/Project programme

List of Experiments

1. Verification of Bernoulli's theorem
2. Determination of hydrostatic force and its location on a vertically immersed surface
3. Determination of friction factor for pipes of different materials
4. Determination of loss coefficients for various pipe fittings
5. Verification of momentum equation
6. Visualization of laminar and turbulent flow, and rotameter

7. Calibration of a venturi-meter
8. Boundary layer over a flat plate

Sample List of Micro-Projects

Students in a group of 4/5 members will be assigned a micro project.

1. Design a physical system to demonstrate the applicability of Bernoulli's equation
2. Determine the pressure distribution around the airfoil body with the help of wind tunnel.
3. Demonstrate the first law of thermodynamics for an open system, for example: a ordinary hair dryer.
4. Develop a computer program for solving pipe flow network.

5. Specific goals for the course

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

- Analyze and solve problems of simple fluid based engineering systems including pressures and forces on submerged surfaces .
- Analyze fluid flow problems with the application of the mass, momentum and energy equations.
- Evaluate practical problems associated with pipe flow systems.
- Conceptualize and describe practical flow systems such as boundary layers and their importance in engineering analysis.
- Estimate fluid properties and solve basic problems using property tables, property diagrams and equations of state.
- Analyze and solve problems related to closed systems and steady-flow devices by applying the conservation of energy principle.
- Analyze the second law of thermodynamics for various systems and to evaluate the performance of heat engines, refrigerators and heat pumps.

6. Brief list of topics to be covered

- Hydrostatics
- Pipe flow
- Fluid mechanics
- Thermostatics

Course Syllabi: UTA011 : Engineering Design –III (L : T : P :: 2 : 0 : 4)

1. Course number and name: UTA011 Engineering Design-III

2. Credits and contact hours: 8.0 and 6

3. Text book, title, author, and year

Text Books / Reference Books

- *Michael McRoberts, Beginning Arduino, Technology in action publications.*
- *Alan G. Smith, Introduction to Arduino: a piece of cake, CreateSpace Independent Publishing Platform (2011)*
- *John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; 1 edition (2013).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Arduino Microcontroller: Features of Ardunio Microcontroller, Architecture of Arduino, Different boards of Arduino, Arduino Interfacing and Applications, Anatomy of an Interactive Device like Sensors and Actuators, a to D converters and their comparison, Blinking an LED, LCD Display, Driving a DC and stepper motor, Temperature sensors, Serial Communications, Sending Debug Information from Arduino to Your Computer, Sending Formatted Text and Numeric Data from Arduino, Receiving Serial Data in Arduino, Sending Multiple Text Fields from Arduino in a Single Message, Receiving Multiple Text Fields in a Single Message in Arduino. Light controlling with PWM.

Introduction to ARM processor: Features of ARM processor, ARM Architecture, Instruction set, ARM Programming

Programming of Arduino: The Code designing step by step. Taking a Variety of Actions Based on a Single Variable, Comparing Character and Numeric Values, Comparing Strings, Performing Logical Comparisons, Performing Bitwise Operations, Combining Operations and Assignment, Using Embedded techniques to program Arduino microcontroller, Understanding the libraries of Arduino programming language and applying for circuit design

Laboratory work: Introduction to Arduino board. Programming examples of Arduino board. Interfacing of LED, seven segment display, ADC and DAC with Arduino board. Introduction to ARM processor kit.

Projects: Arduino and ARM based projects to be allocated by concerned faculty.

5. Specific goals for the course

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

- Understand of features of Arduino board.
- Analyze of internal Architecture of Arduino board.
- Apply Arduino board programming concepts.
- Design and implement Buggy project based on different goals and challenges defined.

6. Brief list of topics to be covered

- ARM Processor

- Arduino Microcontroller
- Programming of Arduino

Course Syllabi: UEE301: Direct Current Machines and Transformers (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE301; Direct Current Machines and Transformers

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008).*
   - *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, DhanpatRai (2004).*
   - *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004).*
   - *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007).*
   - *Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India (2004).*
   - *Fitzgerald, A.E., Kingsley, C. Jr. and Umans, Stephen, Electric Machinery, McGraw Hill (2002).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   General Concepts of Rotating Electrical Machines: Electromagnetic torque, Reluctance torque, Constructional features of rotating electrical machines, Classifications of rotating electrical machines, Construction of DC machines.

   DC Generators: Classification of DC generator, Armature reaction, Compensating windings, Commutation, Methods of improving commutation, Characteristic of DC generators, Voltage buildup of shunt generators, Voltage regulation, Parallel operation of DC generators, Condition for maximum efficiency, Applications of DC generators.

   DC Motors: Characteristic of DC motors, Speed control of DC motors, Ward–Leonard control (Voltage control), Three-point starter, four-point starter, DC shunt motor starter design, Electric breakings of DC shunt and series motors, Condition for maximum mechanical power, Testing of DC machines: Brake test, Swinburne's test, Hopkinson's test or back to back test, Retardation test or Running test, Field's test, Applications of DC motors.

   Single Phase Transformers: Introduction, Basic principle, Types of transformer, Construction, Equivalent circuit, Open circuit and short circuit, Separation of core losses, Per unit representation, Voltage regulation of a transformer, Losses in a transformer, Efficiency of a transformer, Condition for maximum efficiency, All day efficiency, Polarity test of a single–phase transformer, Sumpner's test, Parallel operation, Auto transformer.

   Three-Phase Transformer: Advantages of three phase transformer, Principle of operation, Construction, Three–phase transformer connections, Open delta or V–V connection, Scott connection or T–T connection, Three–phase to two–phase conversion, Three–phase to six–phase conversion, Three–winding transformer, Parallel operation of transformers.

   Special Purpose Transformers: Instrument transformers (CT and PT), Earthing transformer, Pulse transformer, High frequency transformer, Converter transformer.

   Laboratory Work: DC Machines: Characteristics of generators and motors, Speed control, Efficiency, DC generators in parallel. Transformers: Open and short circuit tests, Parallel

operation, Harmonics in no-load current, Three-phase connections, 3−phase to 2−phase and 6−phase conversions.

5. **Specific goals for the course**

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

- Test the transformer and calculate its efficiency and performance in distribution system.
- Compare the performance of auto-transformer with that of two winding transformer.
- Use special purpose transformer for measurement and protection.
- Compute the performance of DC motors and generators in various modes.
- Explain the advantages of increasing load with parallel operation.
- Explain the speed control and starting methods of DC motors for specific purpose(s).

6. **Brief list of topics to be covered**

- General Concepts of Rotating Electrical Machines
- DC Generators
- DC Motors
- Single Phase Transformers
- Three-Phase Transformer
- Special purpose transformers

Course Syllabi: UMA007 : Numerical Analysis (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UMA007 : Numerical Analysis

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Curtis F. Gerald and Patrick O. Wheatley, Applied Numerical Analysis, Pearson, (2003) 7th Edition,*
   - *M. K. Jain, S .R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6th edition.*
   - *Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7^{th} edition (1 March 2014)*
   - *J. H. Mathew, Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2nd edition,*
   - *Richard L. Burden and J. Douglas Faires, Numerical Analysis, Brooks Cole (2004), 8th edition.*
   - *K. Atkinson and W. Han, Elementary Numerical Analysis, John Willey & Sons (2004), 3rd Edition.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.
   Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.
   Linear Systems and Eigen-Values: Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.
   Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.
   Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.
   Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.
   Laboratory Work: Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical techniques using MATLAB.

5. **Specific goals for the course**

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

   - Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.

- Learn how to obtain numerical solution of nonlinear equations using bisection, secant, newton, and fixed-point iteration methods.
- Solve system of linear equations numerically using direct and iterative methods.
- Understand how to approximate the functions using interpolating polynomials.
- Learn how to solve definite integrals and initial value problems numerically.

6. Brief list of topics to be covered

- Floating-Point Numbers
- Non-Linear Equations
- Linear Systems and Eigen-Values
- Interpolation and Approximations
- Numerical Integration
- Differential Equations

Course Syllabi: UES012 Engineering Materials (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UES012 Engineering Materials

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *W.D. Callister , Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.*
   - *W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.*
   - *V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.*
   - *S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.*
   - *L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.*
   - *K. G. Budinski, Engineering Materials – Properties and selection, Prentince Hall India, 1996.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Structure of solids: Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

   Mechanical properties of materials: Elastic, Inelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism and Creep.

   Equilibrium diagram: Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

   Electrical and magnetic materials: Conducting and resistor materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

   Corrosion process: Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

   Materials selection: Overview of properties of engineering materials, Selection of materials for different engineering applications.

   Laboratory Work and Micro-Project:

   Note: The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based on the topic of the project the student will perform any of the six experiments from the following list:

- To determine Curie temperature of a ferrite sample and to study temperature dependence of permeability in the vicinity of Curie temperature.
- To study cooling curve of a binary alloy.
- Determination of the elastic modulus and ultimate strength of a given fiber strand.
- To determine the dielectric constant of a PCB laminate.
- Detection of flaws using ultrasonic flaw detector (UFD).
- To determine fiber and void fraction of a glass fiber reinforced composite specimen.
- To investigate creep of a given wire at room temperature.
- To estimate the Hall coefficient, carrier concentration and mobility in a semiconductor crystal.
- To estimate the band-gap energy of a semiconductor using four probe technique.
- To measure grain size and study the effect of grain size on hardness of the given metallic specimens.

5. Specific goals for the course

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

- Classify engineering materials based on its structure.
- Draw crystallographic planes and directions.
- Distinguish between elastic and plastic behavior of materials.
- Distinguish between Isomorphous and eutectic phase diagram.
- Classify materials based on their electrical and magnetic properties.
- Propose a solution to prevent corrosion.

6. Brief list of topics to be covered

- Structure of solids
- Mechanical properties of materials
- Equilibrium diagram
- Electrical and magnetic materials
- Corrosion process
- Materials selection

Course Syllabi:UHU005: Humanities for Engineers (L : T : P :: 2 : 0 : 2)

1. **Course number and name**: UHU005: Humanities for Engineers

2. **Credits and contact hours**: 3.0 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books

- *Morgan, C.T., King, R.A., Weisz, J.R., &Schopler, J. Introduction to Psychology, McGraw Hill Book Co. (International Student (1986).*
- *N. Tripathi**,** Human Values**,** New Age International (P) Ltd (2009).*
- *Krugman, Paul and Wells Robin, Economics, W.H. Freeman & Co Ltd. Fourth Edition (2015).*
- *RubinfeldPindyck. Microeconomic Theory and application, Pearson Education New Delhi (2012).*
- *Samuelson, Paul, A. and Nordhaus, William, D. Economics, McGraw Hill, (2009).*
- *Mankiw, Gregory N. Principles of Macroeconomics, South-Western College Pub., (2014).*
- *Gregory, Paul R. and Stuart, Robert C. The Global Economy and Its Economic Systems, 2013 South-Western College Pub (2013).*
- *Atkinson, R.L., Atkinson, R.C., Smith, E.E., Bem, D.J. and Nolen-Hoeksema, S. (2000). Hilgard's Introduction to Psychology, New York: Harcourt College Publishers.*
- *Berne, Eric (1964). Games People Play – The Basic Hand Book of Transactional Analysis. New York: Ballantine Books.*
- *Ferrell, O. C and Ferrell, John Fraedrich Business Ethics: Ethical Decision Making & Cases, Cengage Learning (2014).*
- *Duane P. Schultz and Sydney Ellen Schultz, Theories of Personality, Cengage Learning, (2008).*
- *Saleem Shaikh. Business Environment, Pearson (2007).*
- *Chernilam, Francis International Buisness-Text and Cases, Prentice Hall (2013).*
- *Salvatore, Dominick, Srivastav, Rakesh., Managerial Economics: Principles with Worldwide Applications, Oxford, 2012.*
- *Peterson H. Craig. and. Lewis, W. Cris. Managerial Economics, Macmillan Pub Co; (1990).*

   a. Other supplemental materials
   - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

Introduction to Psychology: Historical Background, Psychology as a science. Different perspectives in Psychology.

Perception and Learning: Determinants of perception, Learning theories, Behavior Modification.

Motivational and Affective basis of Behavior: Basic Motives and their applications at work. Components of emotions, Cognition and Emotion. Emotional Intelligence.

Group Dynamics and Interpersonal relationships.

Development of self and personality.

Transactional Analysis.

Culture and Mind.

Practicals:

1. Experiments on learning and behavior modification.
2. Application of Motivation Theories: Need based assessment.
3. Experiments on understanding Emotions and their expressions.
4. Personality Assessment.
5. Exercises on Transactional analysis.
6. Role plays, case studies, simulation tests on human behavior.

HUMAN VALUES and ETHICAL PERSPECTIVE

Values: Introduction to Values, Allport-Vernon Study of Values, Rokeach Value Survey, Instrumental and Terminal Values.

Value Spectrum for a Good Life: Role of Different Types of Values such as Individual, Societal, Material, Spiritual, Moral, and Psychological in living a good life.

Moral and Ethical Values: Types of Morality, Kant's Principles of Morality, Factors for taking ethical decisions, Kohlberg's Theory of Moral Development.
Analyzing Individual human values such as Creativity, Freedom, Wisdom, Love and Trust.

Professional Ethics and Professional Ethos, Codes of Conduct, Whistle-blowing, Corporate Social Responsibility.

Laboratory Work:

Practical application of these concepts by means of Discussions, Role-plays and Presentations, Analysis of Case studies on ethics in business and CSR.

ECONOMIC PERSPECTIVE

Basics of Demand and Supply

Production and cost analysis

Market Structure: Perfect and Imperfect Markets.

Investment Decisions: capital Budgeting, Methods of Project Appraisal.

Macroeconomic Issues: Gross domestic product (GDP), Inflation and Financial Markets.

Globalisation: Meaning, General Agreement on Trade and tariffs (GATT), World Trade Organisation (WTO). Global Liberalisation, and its impact on Indian Economy.

Laboratory Work:

The practicals will cover numerical on demand, supply, market structures and capital budgeting, Trading games on financial markets, Group discussions and presentations on macroeconomic issues. The practicals will also cover case study analysis on openness and globalisation and the impact of these changes on world and Indian economy.

Micro Project: Global Shifts and the impact of these changes on world and Indian economy.

5. Specific goals for the course

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

- Improve the understanding of human behavior with the help of interplay of professional, psychological and economic activities.
- Able to apply the knowledge of basic principles of psychology, economics and ethics for the solution of engineering problems.
- Explain the impact of contemporary issues in psychology, economics and ethical principles on engineering.

6. Brief list of topics to be covered

- Perception and Learning
- Motivational and Affective basis of Behavior
- Value Spectrum for a Good Life
- Moral and Ethical Values
- Investment Decisions
- Globalisation, Macroeconomic Issues

Course Syllabi: UEN002: Energy and Environment (L : T : P :: 3 : 0 : 0)

1. **Course number and name**: UEN002: Energy and Environment

2. **Credits and contact hours**: 3.0 and 3

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Bharucha, E., Textbook of Environmental Studies, Universities Press (2005).*
   - *Chapman, J.L. and Reiss, M.J., Ecology-Principles and Application, Cambridge University Press (LPE) (1999).*
   - *Joseph, B., Environmental Studies, Tata McGraw-Hill (2006).*
   - *Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists, Longman and Harow (2006).*
   - *Miller, G.T., Environmental Science- Working with Earth, Thomson (2006).*
   - *Wright, R.T., Environmental Science-Towards a sustainable Future, Prentice Hall (2008) 9thed.*
   - *O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Environment pollution, global warming and climate change: Air pollution (local, regional and global); Water pollution problems; Land pollution and food chain contaminations; Carbon cycle, greenhouse gases and global warming; Climate change – causes and consequences; Carbon footprint; Management of greenhouse gases at the source and at the sinks

   Ecology, Structure and functioning of natural ecosystems: Ecology, ecosystems and their structure, functioning and dynamics; Energy flow in ecosystems; Biogeochemical cycles and climate; Population and communities

   Natural resources: Human settlements and resource consumption; Biological, mineral and energy resources; Land, water and air; Natural resources vis-à-vis human resources and technological resources; Concept of sustainability; Sustainable use of natural resources

   Agricultural, industrial systems and environment: Agricultural and industrial systems vis-à-vis natural ecosystems; Agricultural systems, and environment and natural resources; Industrial systems and environment

   Energy technologies and environment: Electrical energy and steam energy; Fossil fuels, hydropower and nuclear energy; Solar energy, wind energy and biofuels; Wave, ocean thermal, tidalenergy and ocean currents; Geothermal energy; Future energy sources; Hydrogen fuels; Sustainable energy

   Group assignments: Assignments related to Sanitary landfill systems; e-waste management; Municipal solid waste management; Biodiversity and biopiracy; Air pollution control systems; Water treatment systems; Wastewater treatment plants; Solar heating systems; Solar power plants; Thermal power plants; Hydroelectric power plants; Biofuels; Environmental status assessments; Energy status assessments etc.

5. **Specific goals for the course**

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

- Correlate major local and regional environmental issues with changes in ecology and human health.
- Monitor and document the development and dynamics of ecosystems in experimental or natural microcosms.
- Define and document local resource consumption patterns and conservation strategies.
- Define opportunities available for energy conservation and for use of renewable energy resources in local and regional entities.

6. Brief list of topics to be covered

- Environment pollution, global warming and climate change
- Ecology, Structure and functioning of natural ecosystems
- Natural resources
- Agricultural, industrial systems and environment
- Energy technologies and environment
- Group assignments

Course Syllabi: UEE505: Analog and Digital Systems (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE505: Analog and Digital Systems

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Boylestad R. L., Electronic Devices and Circuit Theory, Pearson Education (2007).*
- *Millman, J. and Halkias, C.C., Integrated Electronics, Tata McGraw Hill (2006).*
- *Floyd, T.L. and Jain, R. P., Digital Fundamentals, Pearson Education (2008).*
- *Tocci, R. and Widmer, N., Digital Systems: Principles and Applications, Pearson Education (2007).*
- *Neamen, Donald A., Electronic Circuit Analysis and Design, McGraw Hill (2006).*
- *Sedra A. S. and Smith K. C., Microelectronic Circuits, Oxford University Press (2006).*
- *Mano, M. M. and Ciletti, M., Digital Design, Pearson Education (2008).*
- *Kumar, A., Fundamentals of Digital Circuits, Prentice Hall (2007).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Bipolar Junction Transistor and Field Effect Transistor: Different configurations and their static characteristics; CE configuration as two port network: h–parameters, h–parameter equivalent circuit; Biasing and load line analysis; High frequency operation of BJT; Structure and working of JFET and MOSFET; output and transfer characteristics, Applications of JFET and MOSFET

Oscillators and Wave Shaping Circuits: Condition for sustained oscillation, R-C phase shift, Hartley, Colpitts, Crystal and Wien Bridge Oscillators, Negative Resistance oscillator; Switching characteristics of diodes and transistors including square wave response, High pass and low pass filters using R-C Circuits; R–L, R–L–C circuits, Attenuators; Clipping and clamping circuits; Clamping circuit theorem; Comparators; Multivibrators.

Simplification of Boolean Expressions: Quine-McClusky method in SOP and POS forms, determination of prime implications, simplification using Map-entered variables.

Combinational and Sequential Circuits: Introduction, Adders: Parallel Binary adder, Serial adder, BCD adder, Subtractors, Binary multiplier, Dividers, ALU, Code converters, Magnitude comparators, Parity Generators/checkers, Encoders, Decoders, Multiplexers, Demultiplexer; Introduction of sequential circuits, Flip-flops, Registers: Serial/Parallel in/out, Bi-directional, Universal shift register, Counters: Synchronous, Asynchronous, Decade, Binary, Modulo-n, Shift register counters; Design of Synchronous sequential circuits, FSM, Concept of Moore and Mealy machines, Synchronous detector.

Memories: Introduction and classification of ROM, ROM organization, Static and Dynamic RAM, DRAM Refreshing, Representative circuits for cells using BJT and FET's, Timing diagrams of memories, Memory expansion using IC's, Flash memory, CCD, Magnetic Memories.

Converters: Digital to Analog conversion, R2R ladder DAC, Weighted Resistor DAC, Analog-Digital conversion, Flash type, Counter type ADC, Dual-slope ADC, Successive approximation type ADC.

Laboratory Work: Series voltage regulator, RC coupled amplifier in CE mode, Use of Bistable, Astable and monostable multivibrator, Hartley and Colpitts Oscillator, shift register and binary counting using JK flip flop, asynchronous/synchronous up/down counters, Variable modulus counters, Usage of IC tester, Computer simulation using EDA tools.

Minor Project: Design of LED lighting system for household application; street lighting system; soft starting of DC machine.

5. Specific goals for the course

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

- Design different type of circuits such as rectifiers, clippers, clampers, filters etc.
- Design power supplies and solve problems related to amplifiers and oscillators.
- Design combinational and sequential circuits.
- Differentiate various type of memories and there use in different applications.
- Demonstrate the concept of logic circuits and converters.

6. Brief list of topics to be covered

- Floating-Point Numbers
- Non-Linear Equations
- Linear Systems and Eigen-Values

Course Syllabi: UEE405: Network Theory and Design (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE405: Network Theory and Design

2. **Credits and contact hours**: 8.0 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Hayt, W., Engineering Circuit Analysis, Tata McGraw–Hill (2006).*
- *Hussain, A., Networks and Systems, CBS Publications (2004).*
- *Valkenberg, Van, Network Analysis, Prentice–Hall of India Private Limited (2007).*
- *Gayakwad, A. Op-Amps and Linear Integrated Circuits, Prentice–Hall of India (2006).*
- *Chakarbarti,A., Circuit Theory, DhanpatRai and Co. (P) Ltd. (2006).*
- *Roy Chowdhuary, D., Networks and Systems, New Age International (P) Limited, Publishers (2007).*
- *Sudhakar, A., Circuits and Networks, Tata McGraw–Hill (2006).*
- *Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education, (2009).*

a. Other supplemental materials

- Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Graph Theory: Graph, Tree and link branches, Network matrices and their relations, Choice of linearly independent network variables, Topological equations for loop current and topological equation for nodal voltage, Duality

Network Theorems: Source transformation, Superposition Theorem, Thevenin's theorem, Norton's theorem, Millman's theorem, Reciprocity theorem and Maximum power transfer theorem as applied to A.C. circuits, Compensation theorem, Tellegen's theorem and their applications.

Two Port Networks: Two port network description in terms of open circuits impedance, Short circuit admittance, Hybrid and inverse hybrid, ABCD and inverse ABCD parameters, Inter-connection of two port network, Indefinite admittance matrix and its applications.

Network Functions: Concepts of complex frequency, Transform impedance, Networks function of one port and two port network, concepts of poles and zeros, property of driving point and transfer function.

Passive Network Synthesis: Introduction, Positive Real Functions: Definition, Necessary and sufficient conditions for a function to be positive real, Synthesis vs. analysis, Elements of circuit synthesis, Foster and cauer forms of LC Networks, Synthesis of RC and RL networks.

Filters and Attenuators: Classification of filters, Analysis of a prototype low pass filter, High pass filter, Band pass filter, Band stop filter, M–derived filter, Attenuation, Types of attenuators: symmetrical and asymmetrical.

Active Filters and Oscillators: Introduction to Active filters, first and second order low pass Butterworth filter, First and second order high pass Butterworth filter, Band pass filter, Oscillators: Principles, types, Phase shift Oscillators, Wein Bridge Oscillators, Square wave generators.

Laboratory Work:

Verification of Network Theorems, Determination of Z, Y, hybrid and ABCD parameters of two port network, Inter-connection of two port networks, Analysis of T and ∏-Attenuator Networks.

5. Specific goals for the course

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

- Apply the various laws and theorems related to electric networks.
- Explain the concept of two port networks.
- Familiarization with network synthesis.
- Theory and designing of passive filters and attenuators.
- Design of active filters.

6. Brief list of topics to be covered

- Graph Theory
- Network Theorems
- Two Port Networks
- Network Functions
- Passive Network Synthesis
- Filters and Attenuators
- Active Filters and Oscillators

Course Syllabi: UEE401: Alternating Current Machines (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE401: Alternating Current Machines

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Bimbhra, P.S., Electrical Machinery, Khanna Publishers (2008).*
- *Mukherjee, P.K. and Chakravorty, S., Electrical Machines, DhanpatRai and Co. (P) Ltd. (2004).*
- *Nagrath, I.J. and Kothari, D.P., Electric Machines, Tata McGraw Hill (2004).*
- *Bimbhra, P.S., Generalized Theory of Electrical Machines, Khanna Publishers (2007).*
- *Toro, Vincert, Electromechanical Devices for Energy Conversion, Prentice Hall of India (2004).*
- *Fitzgerald, A.E., Kingsley, C. Jr., and Umans, Stephen, Electric Machinery, McGraw–Hill (2002).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Three–Phase Induction Motors: Construction, working principle, Slip and its effect on rotor parameters: rotor frequency, Torque–slip characteristics, Power flow diagram, Efficiency, Synchronous watt, Measurement of slip, Equivalent circuit, No–load test, Blocked rotor test, Circle diagram, Starting methods, Speed control methods, Crawling, Cogging, Deep cage and Double cage rotors, Applications, self excited and grid connected Induction generator.

Fractional kW Motors and Special Machines: Classification, Production of rotating field, Double revolving field theory, Equivalent circuit, Determination of equivalent circuit parameters, Split phase induction motor, Capacitor motor, Permanent split capacitor motor; Shaded pole motor, Universal motor, Stepper motor.

Synchronous Generators/Alternators: Introduction, Comparison with DC generator, Advantages of rotating field over rotating armature, Constructional features, Excitation systems, Armature windings, EMF equation, Winding factor, Harmonics, Armature resistance, Armature reaction: Unity power factor, Zero lagging and Zero leading power factor, Armature reaction reactance, Equivalent circuit of an alternator, Voltage equation, Phasor diagram of a loaded alternator for various types of loads, Voltage regulation and methods of estimation of voltage regulation, Load characteristic of alternators, power equation, Two reaction theory and Torque–angle characteristic of a salient–pole alternator, Maximum reactive power for a salient–pole alternator, Losses and efficiency, Determination of X_d and X_q, Parallel operation of alternators, Synchronising procedures, Synchronising power and Torque co–efficient, Damper Windings, Hunting.

Synchronous Motors: Voltage equation, Phasor diagram, Operation at constant load with variable excitation, Power equations, salient pole Synchronous motor, Starting of synchronous motors, Applications, Synchronous condensers.

Laboratory work: Voltage regulation, Direct and quadrature axis reactances, Operating characteristics, Synchronizing, Parallel operation and load division, Sudden short circuit

analysis and determination of sub transient, Transient and steady state reactances and various time constants, Determination of positive, negative and zero sequence reactances, Synchronous motor starting, Efficiency. Three phase induction motors: starting methods, Equivalent circuit parameters, Load test, Polarity test, Single phasing, Efficiency, Schrage motor, Single-phase induction motors: Equivalent circuit parameters and performance indices.

5. Specific goals for the course

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

- Simulate the steady-state and transient state performance of induction and synchronous machines.
- Validate and identify the machine parameters.
- Select the appropriate AC motor for different large power application.
- Analyse the stability of single machine – infinite bus system and form the grid to supply large load.
- Choose the appropriate fractional horse power motor as per the usage in daily life.

6. Brief list of topics to be covered

- Three–Phase Induction Motors
- Fractional kW Motors and Special Machines
- Synchronous Generators/Alternators
- Synchronous Motors

Course Syllabi: UEE403: Measurement and Transducers (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UEE403: Measurement and Transducers

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Golding, E.W., and Widdis, F.C., Electrical Measurements and Measuring Instruments, Pitman (2003).*
- *Sawhney, A.K., a Course in Electrical and Electronic Measurements and Instrumentation, DhanpatRai and Co. (P) Ltd. (2007).*
- *Nakra, B. C. and Chaudhry, K. K., Instrumentation Measurement and Analysis, Tata McGraw–Hill (2003).*
- *Murthy, D.V.S., Transducers and Instrumentation, Prentice–Hall of India Private Limited (2003).*
- *Doeblin, E.O., Measurement systems, Applications and Design, McGraw–Hill (1982).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Units, Systems and Standards: SI units, Classification of standards, Time and frequency standards, Electrical standard.

Electromechanical Indicating Instruments: PMMC galvanometer, Ohmmeter, Electrodynamometer, Moving iron meter, Rectifier and thermo-instruments, Comparison of various types of indicating instruments.

Power and Energy Measurement: Electrodynamometer type of wattmeter and power factor meter, Single-phase induction and Electronic energy meters.

Bridges for Measurement: Kelvin double bridge, AC bridges: Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, Low and High resistance measurement.

Electronic Instruments: Electronic multi-meter, Quantization error, Digital frequency meter, Q meter, Spectrum Analyzer, Digital Storage Oscilloscopes.

Sensors and Transducers: Basic principle and applications of Resistive, Inductive, Capacitive and, Piezoelectric sensors, Synchros and Resolvers, Fiber optic sensors, Hall-Effect, Photo transducer, Photovoltaic, Digital transducers, Tacho-generators, shaft parameters measurement in rotating shafts.

5. **Specific goals for the course**

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

- Select various types of instruments for measurement of variables.
- Select and use various types of sensors in different conditions.
- Select and use various types of bridge circuits with different sensors.
- Explain the working of electronic instruments.
- Explain the working of sensors and transducers.

6. **Brief list of topics to be covered**
    - Units, Systems and Standards
    - Electromechanical Indicating Instruments
    - Power and Energy Measurement
    - Bridges for Measurement
    - Electronic Instruments
    - Sensors and Transducers

Course Syllabi: UEE404: Transmission and Distribution of Power (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEE404: Transmission and Distribution of Power

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Chakrabarti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Power System Engineering, DhanpatRai (2008).*
- *Wadhwa, C.L., Electrical Power Systems, New Age International (P) Limited, Publishers (2008).*
- *Gupta, B.R., Power System Analysis and Design, S. Chand (2009).*
- *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw–Hill (2007).*
- *Pabla, A.S., Electric Power Distribution, McGraw Hill (2008).*
- *Stevenson, W.D., Power System Analysis, McGraw–Hill (2007).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Introduction: Structure of power systems, Growth of power systems–Indian overview, Interconnections and their advantages.

Transmission Line Parameters: Choice of voltage and frequency, Types of conductor, Size of conductor, Resistance, Inductance and capacitance of single phase and three phase transmission lines.

Mechanical design of overhead transmission lines: Tension and sag calculations, Factors affecting Sag, Sag template, Stringing charts, Vibrations and vibration damper.

Insulators: Insulator types, String efficiency, Improvement of String Efficiency Grading rings, Insulator arc Failure, Arcing horns, Armored rods and Bushing.

Transmission Line Performance: Characteristics and performance of power transmission lines: Short, Medium, Long lines, Generalized constants, Power flow, regulation, Power circle diagrams, Series and shunt compensation, Corona visual and disruptive, Critical voltage, Phenomenon of Corona, Corona loss, Factors affecting Corona, Ferranti Effect, Electrostatic and Electromagnetic interference with communication lines.

Insulated Cables: Constructional features, Parameters, Cable laying procedures, Fault location Methods, High voltage cables, Thermal characteristics, Ratings of Cables, Introduction to XLPE cables.

Distribution Systems: Classification of distribution system, Primary and secondary distribution, Ring main and radial systems, Systematic design of distribution systems.

EHV transmission and HVDC transmission: Need of EHV transmission system, types of DC links, advantages of DC transmission, HVDC systems in India.

5. **Specific goals for the course**

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

- Analyse the transmission line models and evaluate its performance parameters.
- Design the transmission lines under various working conditions.

- Describe and select the configurations of different line insulators and evaluate their performance.
- Supervise the laying of cables and fault detection in cables.
- Design the distribution system network.

6. Brief list of topics to be covered

- Transmission Line Parameters
- Mechanical design of overhead transmission lines
- Insulators
- Transmission Line Performance
- Insulated Cables
- EHV transmission and HVDC transmission

Course Syllabi: UEE507: Engineering Electromagnetics (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEE507: Engineering Electromagnetics

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Hayt, W.H., Engineering Electromagnetics, Tata McGraw–Hill (2008).*
   - *Kraus, J.D., Electromagnetics, McGraw–Hill (2006).*
   - *Sadiku, M.N.O, Elements of Electromagnetics, Oxford University Press (2009).*
   - *Jordan, E.C. and Balmain K.G., Electromagnetic Waves and Radiating Systems, Prentice Hall of India (2008).*
   - *Paramanik, A, Electromagnetism: Theory and Applications, Prentice–Hall of India (2006).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Vector Analysis: Review of vector algebra, Review of cartesian, Cylindrical and spherical coordinate systems, Introduction to del ∇ (operator, Use of del operator as gradient, divergence,curl).

   Electrostatic fields: Introduction to coulomb's law, Gaussian law and its applications in determination of field of spherical and cylindrical geometries, Laplace's and poission's equation in various coordinate systems. Effect of dielectric on capacitance, Boundary conditions at electric interfaces, Method of images and its applications.

   Magnetostatics: Introduction to ampere's law, Magnetic vector potential, Magnetic forces, Boundary conditions at magnetic interfaces.

   Time Varying Fields andMaxwell's Equations: Continuity of charge, Concept of displacement current, Maxwell's equation in integral and differential form: for static fields, for time varying fields, for free space, for good conductors, for harmonically varying fields, Poynting theorem: Energy stored and radiated power, Complex poynting vector, Properties of conductor and dielectrics, Wave equations for free space, Wave equations for conductors.

   Uniform Plane Waves: Introduction, Uniform plane wave propagation: Wave equations, Transverse nature of uniform plane waves, Perpendicular relation between $\vec{E}$ and $\vec{H}$, EM waves in charge free, Current free dielectric, Reflection by ideal conductor: Normal incidence, reflection and transmission with normal incidence at another dielectric, Plane wave in lossy dielectric, Wave impedance and propagation constant, Depth of penetration, Surface impedance and surface resistance, Application of EM propagation through Transmission Lines and Rectangular Waveguides

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Appraise need analysis for different coordinate systems in electromagnetics and their interrelations.
   - Apply vector calculus to solve field theory problems.

- Calculate electric and magnetic fields in different coordinates for various charge and current configurations.
- Exhibit the concept of time varying fields.
- Demonstrate different aspects of plane wave in dielectric and conducting media.
- Realize the analogy of wave with transmission line and determine the transmission line performance.

6. Brief list of topics to be covered

- Vector Analysis
- Electrostatic fields
- Magnetostatics
- Time Varying Fields and Maxwell's Equations
- Uniform Plane Waves

Course Syllabi: UEE504: Power Electronics (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE504: Power Electronics

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Dubey, G.K., Doradla, S.R., Joshi, A. and Sinha, R.M.K., Thyristorised Power Controllers, New Age International (P) Limited, Publishers (2004).*
   - *Rashid, M., Power Electronics, Prentice–Hall of India (2006).*
   - *Bimbhra,P.S., Power Electronics, Khanna Publishers(2012).*
   - *Mohan, N., Underland, T. and Robbins, W. P., Power Electronics: Converter Applications and Design, John Wiley (2007) 3rd ed.*
   - *Bose, B.K., Handbook of Power Electronics, IEEE Publications.*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Introduction to Thyristors and its family, static and dynamic characteristics, turn-on and turn-off methods and firing circuits, Ratings and protection of SCRs, series and parallel operation.

   Phase Controlled Converters: Principle of phase control, Single phase and three phase converter circuits with different types of loads, continuous and discontinuous conduction, effect of source inductance, Dual converters and their operation**.**

   DC Choppers: Principle of chopper operation, control strategies, types of choppers, step up and step down choppers, steady state time domain analysis with R, L, and C type loads, voltage, current and load commutated choppers.

   Inverters: Single phase voltage source bridge inverters and their steady state analysis, modified Mcmurray half bridge inverter, series inverters, three phase bridge inverters with 180^0 and 120^0 modes. single-phase PWM inverters, current source inverters, CSI with R load (qualitative approach).

   AC Voltage Controllers: Types of single-phase voltage controllers, single-phase voltage controller with R and RL type of loads.

   Cycloconverters: Principles of operation, single phase to single phase step up and step down cycloconverters, three phase to single phase cycloconverters, output voltage equation for a cycloconverter.

   Laboratory Work: SCR V-I characteristics, Gate firing circuit, DC -DC chopper, Semi converter and Full converter with R , RL and RLC type of loads, DC shunt motor speed control, Single phase AC voltage controller with R load, Inverters, Simulation of power electronics converters.

   Minor Project: Design and development of power converters

5. **Specific goals for the course**

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

   - Select the power devices as per the usage for energy conversion and control.

- Exhibit the designing of firing and commutation circuits for different converter configurations.
- Analyse various converter configuration / topology with different types of load.
- Identify converter configurations for various power applications.
- Exhibit the usage of power converters for harmonic mitigation, voltage and frequency control.

6. Brief list of topics to be covered

- Thyristors
- Phase Controlled Converters
- DC Choppers
- Inverters
- AC Voltage Controllers
- Cycloconverters

Course Syllabi: UEI404: Digital Signal Processing Fundamentals (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UEI404: Digital Signal Processing Fundamentals

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Proakis, J.G. and Manolakis, D.G., Digital Signal Processing, Prentice Hall of India (1996).*
   - *Rabiner, C.R. and Gold, B., Theory and Applications of Digital Signal Processing, Prentice Hall of India (2000)*
   - *Antonion, A., Digital Filters: Analysis Design and Application, Prentice-Hall of India (1999).*
   - *Oppenhein, A.V. and Schafer, R.W., Digital Signal Processing, Prentice-Hall of India (1998).*
   - *Helmut, U. and Willibald, W., Protection Techniques in Electrical Engg. Systems, Marcel Dekker Inc. (2001)*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

Introduction: Definition, conversion from analog signal to digital signal, advantages and disadvantages of digital signal processing, Basic Terminologies.

z-Transform: Region of Convergence (ROC), Properties of z-transform, Initial and Final Value theorems, Partial Sum, Parseval's Theorem, z-transform of standard sequences, Inverse z-transform, Pole-Zero plot, System function of LTI system, Causality and Stability in terms of z-transform.

DFT and FFT: Discrete Fourier Series, Discrete Fourier Transform and its Properties, Efficient Computation of DFT using FFT algorithms, Linear Filtering Approach to Computation of DFT.

Digital Filter Structure: Describing Equation, Structures for FIR Systems, Structures for IIR Systems, Representation of Structures using Signal Flow Graph.

Design of Digital Filters: Introduction, Difference between analog and digital filters, Implementation of digital filter, Types of filters, LTI systems as filters, Design of IIR filters from analog filters, IIR filter design using Butterworth Approximation, Frequency transformation, FIR filters design, Least square filter design, Designing digital filter from pole-zero placement, Butterworth filter design using Bilinear transformation, FIR filter design using windows, Design of filters using pole-zero combination, Analysis of coefficient quantization effects in FIR filters, Analysis of round-off errors, Dynamic range scaling, Low sensitivity digital filters, Limit cycles in IIR filters.

Hardware Architecture of DSP Processor: Desirable features of DSP processors, Types of architectures, Internal architecture, Features, System interface and Instruction set of ADSP-21xx, ADSP-21xx, Development tools, TMS DSP processor.

Applications: Dual-tone multi frequency signal detection, Spectral analysis using DFT, Short term DFT, oversampling, Protection.

5. **Specific goals for the course**

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

   - Explain the digital signal processing concepts and stability analysis of digital system.
   - Demonstrate the hardware architecture of DSP Processor.
   - Design digital filter and harmonic mitigation.
   - Carryout spectrum analysis using DFT.
   - Apply DSP concepts for power system purposes such as relaying, protection and metering.

6. **Brief list of topics to be covered**

   - z-Transform
   - DFT and FFT
   - Digital Filter Structure
   - Design of Digital Filters
   - Hardware Architecture of DSP Processor
   - Applications

Course Syllabi:UTA012: Innovation and Entrepreneurship (L : T : P :: 1 : 0 : 2)

1. **Course number and name**: UTA012: Innovation and Entrepreneurship

2. **Credits and contact hours**: 3 and 4.5

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Ries, Eric(2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.*
- *Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.*
- *S. Carter and D. Jones-Evans, Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)*
- *T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)*
- *Osterwalder, Alex and Pigneur, Yves (2010) Business Model Generation.*
- *Kachru, Upendra, India Land of a Billion Entrepreneurs, Pearson*
- *Bagchi, Subroto, (2008), Go Kiss the World: Life Lessons for the Young Professional, Portfolio Penguin*
- *Bagchi, Subroto, (2012). MBA At 16: a Teenager's Guide to Business, Penguin Books*
- *Bansal, Rashmi, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad*
- *Bansal, Rashmi, (2013). Follow Every Rainbow, Westland.*
- *Mitra, Sramana (2008), Entrepreneur Journeys (Volume 1), Booksurge Publishing*
- *Abrams, R. (2006). Six-week Start-up, Prentice-Hall of India.*
- *Verstraete, T. and Laffitte, E.J. (2011). a Business Model of Entrepreneurship, Edward Elgar Publishing.*
- *Johnson, Steven (2011). Where Good Ideas comes from, Penguin Books Limited.*
- *Gabor, Michael E. (2013), Awakening the Entrepreneur Within, Primento.*
- *Guillebeau, Chris (2012), The $100 startup: Fire your Boss, Do what you love and work better to live more, Pan Macmillan*
- *Kelley, Tom (2011), The ten faces of innovation, Currency Doubleday*
- *Prasad, Rohit (2013), Start-up sutra: what the angels won't tell you about business and life, Hachette India.*

a. Other supplemental materials
- Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges.

Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches**,** Effectuation and Causation.

Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

5. Specific goals for the course

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

- Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
- Demonstrate an ability to design a business model canvas.
- Evaluate the various sources of raising finance for startup ventures.
- Understand the fundamentals of developing and presenting business pitching to potential investors.

6. Brief list of topics to be covered

- Entrepreneurial Opportunities
- Entrepreneurial Process and Decision Making
- Crafting business models and Lean Start-ups
- Organizing Business and Entrepreneurial Finance

Course Syllabi: UEI609: Fundamentals of Microprocessors and Microcontrollers (L:T:P::3:1:2)

1. **Course number and name**: UEI609: Fundamentals of Microprocessors and Microcontrollers

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Hall, D.V., Microprocessor- Interfacing Programming and Hardware, Tata McGraw–Hill (1997).*
- *Ayala, K.J., The 8051 Microcontroller Architecture, Programming and applications, Penram International Publishing (India) Pvt. Ltd. (2007).*
- *Mazidi, M.A., The 8051 Microcontroller and Embedded System, Pearson Education (2008).*
- *Brey, B.B., The INTEL Microprocessors, Prentice–Hall of India Private Limited (2002).*
- *Liu, Y. C. and Gibson, G.A., Microcomputer Systems: The 8086/8088 Family–Architecture, Programming and Design, Prentice–Hall of India Private Limited (2007).*
- *Uffenbeck, J., The 8086/ 8088 Family, Prentice–Hall of India Private Limited (1994).*
- *Predko, M., Customizing The 8051 Microcontroller, Tata McGraw–Hill (2002).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

INTEL 8086 Microprocessor: Pin Functions, Architecture, Characteristics and Basic Features of Family, Segmented Memory, Addressing Modes, Instruction Set, Data Transfer Instructions, Arithmetic, Logical, Shift and Rotate Instructions, String Instructions, Flag Control Instructions, Transfer of Control Instructions, Processor Control Instructions, Programming Examples, Interrupt Structures, Multitasking and Multiprogramming, MIN/MAX Modes of 8086,Co-processors 8087 and 8089.

Introduction to 8051 Microcontroller: 8051 architecture and pin diagram, Registers, Timers, Counters, Flags, Special Function Registers, Addressing Modes, Data types, instructions and programming, Single–bit operations, Timer and Counter programming, Interrupts programming, Serial communication, Memory accessing and their simple programming applications.

Hardware interfacing: I/O Port programming, Bit manipulation, Interfacing to a LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors.

Laboratory work: Introduction to INTEL kit, Programming examples of 8086, Interfacing using 8086 kits, ADC, DAC, 8253, Microprocessor based project, Programming and Application development around 8051, Interfacing to LED, LCD, Keyboard, ADC, DAC, Stepper Motors and sensors etc.

5. Specific goals for the course

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

- Demonstrate the concept of microprocessor and to be able to design a microprocessor based system to get desired results.

- Use 8086 microprocessor in advanced applications, which will give them a good platform to work further.
- Graduates will be able to update with current trends through self-study and show genuine need to learn on continuous basis.
- Students will be able to use hardware interfacing of 8051 to develop solutions of real world electrical problems.

6. Brief list of topics to be covered

- 8086 Microprocessor
- 8051 microcontroller
- Hardware interfacing

Course Syllabi: UEI501: Control Systems (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEI501: Control Systems

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Gopal, M., Digital Control System, Wiley Eastern (1986).*
- *Nagrath, I.J. and Gopal, M., Control System Engineering, New Age International (P) Limited, Publishers (2003).*
- *Ogata, K., Modern Control Engineering, Prentice–Hall of India Private Limited (2001).*
- *Kuo, B.C., Automatic Control System, Prentice–Hall of India Private Limited (2002).*
- *Sinha, N.K., Control System, New Age International (P) Limited, Publishers (2002).*

a. Other supplemental materials

- Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Basic Concepts: Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, , Block diagrams and signal flow graphs.

Components: D.C. and A.C. Servomotors, D.C. and A.C. Tachogenerators, Potentiometers and optical encoders, Synchros and stepper motors

Analysis: Steady-state errors and error constants, Concepts and applications of P, PD, PI and PID types of control.

Stability: Definition, Routh-Hurwitz criterion, Root locus techniques, Nyquist criterion, Bode plots, Relative stability, Gain margin and phase margins.

Compensation: Lead, Lag and lag-lead compensators, Design of compensating networks for specified control system performance.

State Space Analysis: Concepts of state, State variables and state models, State space equations, Transfer function, Transfer model, State space representation of dynamic systems, State transition matrix, Decomposition of transfer function, Controllability and observability.

Laboratory : Linear system simulator, Compensation design, D.C. position control and speed control, Synchro characteristics, Servo demonstration, Stepper motor, Potentiometer error detector, Rate control system, Series control system, Temperature control system.

5. Specific goals for the course

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

- Develop the mathematical model of the physical systems.
- Analyze the response of the closed and open loop systems.
- Analyze the stability of the closed and open loop systems.
- Design the various kinds of compensator.
- Develop and analyze state space models.

6. Brief list of topics to be covered

- Open loop and closed loop system

- Steady state analysis
- Stability
- Compensation
- State space analysis

Course Syllabi: UEE605: Power System Analysis and Stability (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE605: Power System Analysis and Stability

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Power System Engineering, DhanpatRai and Co. (P) Ltd. (2008).*
   - *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw–Hill (2007).*
   - *Stevenson, W.D., Power System Analysis, McGraw–Hill (2007).*
   - *Gupta, B.R., Power System Analysis and Design, S.Chand and Company Limited (2009).*
   - *Pabla, A.S., Electric Power Distribution, Tata McGraw–Hill (2008).*
   - *Wadhwa, C.L., Electrical Power Systems, New Age International (P) Limited, Publishers (2008).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

   Representation of Power System: Representation of power system components, regulating transformers generators, transmission line and loads, phase shift in star-delta transformer, sequence impedance of transmission line, transformer and generators, sequence networks of power system, Y-Bus and Z-Bus building algorithm.
   Load Flow Study: Load flow problem, power flow equations, load flow solution using Gauss Seidal and Newton Raphson methods, decoupling between real and reactive power control, decoupled and fast decoupled methods, comparison of load flow methods.
   Fault Analysis: Symmetrical fault, algorithm for symmetrical fault analysis, unbalanced faults (Single line to ground fault, Line to line and double line to ground, Open conductor), Bus Impedance matrix method for the analysis of unsymmetrical shunt faults.
   Power System Stability: Concepts of types of stability limits, steady state stability analysis, transient stability analysis, Swing equation and its solution by point-by-point method, Equal area criterion, critical clearing angle and improvement of transient stability.
   Laboratory work: Develop software for various matrix inversion techniques, load flow problems with all methods, Fault analysis and stability studies; Use of standard software for simulation and steady state analysis of power system.

5. **Specific goals for the course**
   After the completion of the course, the students will be able to:
   - Develop an appropriate mathematical model of power system
   - Carry out power flow analysis of practical power system for balanced system.
   - Conduct studies during balanced faults to decide the fault levels and circuit breaker ratings.
   - Conduct studies during unbalanced faults to decide the fault levels and circuit breaker ratings.

- Analyze the stability of single machine-infinite bus system and can decide the critical clearing time of circuit breakers.

6. Brief list of topics to be covered

- Representation of Power System
- Load Flow Study
- Fault Analysis
- Power System Stability

Course Syllabi: UEE603: Switchgear and Protection (L: T: P: :3: 0 : 2)

1. **Course number and name**: UEE603: Switchgear and Protection

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Chakraborti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Power System Engineering, DhanpatRai and Co. (P) Ltd. (2008).*
   - *Pathinkar, Y.G. and Bhide, S.R., Fundamentals of Power System Protection, PHI Learning Pvt. Limited (2008).*
   - *Rao, S.S., Switchgear and Protection, Khanna Publishers (2007).*
   - *Deshpande, M.V., Switchgear and Protection, Tata McGraw−Hill (2005).*
   - *Elmore, W.A., Protective Relaying Theory and Applications, ABB Power T and D Company Inc. (2003).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: a protection system and its attributes, System transducers, duties of switchgear, various power system elements that needs protection.

   Fuses: Types, ratings and characteristics, construction and application of HRC fuses, limitations and application of fuses, Introduction to MCBs.

   Circuit Breakers: Theory of arc formation and its extinction (AC and DC), re-striking and recovery voltage, Current chopping, circuit breakers: specifications of circuit breakers, different types of circuit breakers like oil, Air, Vacuum and SF_6, comparative merits and demerits, HVDC circuit breaker system.

   Earthing: Earthing requirements, Earthing practices, Earth resistivity and earth gradient, Neutral shift.

   Protective Relays: Functions, Constructional and operating principles of electromagnetic type like over-current, Directional, Differential and distance relays, Characteristics, General equation. Basic principles of static relaying, Phase and amplitude comparator, Microprocessor based relays.

   Protection Schemes: Over−current and Over−voltage protection of transmission lines, differential protection, transformer protection, Bus bar protection, distance protection of transmission line, carrier aided protection of transmission lines, generator protection, induction motor protection.

   Laboratory work: Sequence impedance and their calculations, Symmetrical fault level measurement on a D.C. network analyzer, Unsymmetrical fault level measurement on a D.C. network analyzer for various types of faults, Measurement of ground resistivity and resistance of a ground electrode, Plotting of characteristics of different types of relays, Performance or different types of protection schemes, ABCD constants of an artificial transmission line, String efficiency of insulator string, use of standard software package for short circuit studies and relay co-ordination.

5. **Specific goals for the course**

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

- Explain various protection strategies applied for power system protection.
- Select the protection elements namely fuse, circuit breakers and relays for a given configuration.
- Design the basic Earthing requirement for residential and other purposes.
- Select required protection measures against overcurrent, overvoltage in transmission lines.
- Select suitable protection scheme for different power system equipment.

6. **Brief list of topics to be covered**

- Introduction of switchgear protection.
- Fuses
- Circuit Breakers
- Earthing
- Protective Relays
- Protection Schemes

Course Syllabi: UEE801: Electric Drives (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE801: Electric Drives

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Dubey, G.K., Power Semiconductor Controlled Drives, Prentice Hall Inc. (1989).*
   - *Pillai, S.K., a Course in Electric Drives, New Age International (P) Limited, Publishers (1989).*
   - *Bose, B.K., Modern Power Electronics and AC Drives, Prentice-Hall of India Private Limited (2006).*
   - *Dubey, G.K., Fundamentals of Electric Drives, Narosa Publications (2001).*
   - *Sen, P.C., Thyristor DC Drives, John Wiley and Sons (1981).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

   Definitions and Dynamics of Electric Drives: Concept of electric drive and its classifications, Types of loads, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination, Steady state stability of an electric drive system, Load Equalization.

   Drive Features of Importance: Multi-quadrant operations of DC and AC motors, Energy relations during starting and braking.

   Static Control of Motors: Contactors and relays for electric drives, Control circuits for automatic starters of DC and AC motors.

   Estimation of Motors Rating: Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load diagrams.

   Solid State Controlled Drives: Control of DC drives fed through single-phase and three-phase semi-converter and full-converter phase-controlled configurations, their analysis, Regeneration and braking through static power converters, control of three phase induction motors by stator voltage and frequency control for speeds below and above synchronous speed, Static rotor resistance control, Static kramer and scherbius drives, V/f and Vector control, Energy efficient drives, losses in electrical drive system, Energy conservation in electric drives.

   Laboratory work: Starting and running characteristics of converter fed AC and DC motor control, Harmonic analysis of AC and DC Drives, V/f based drive, Microprocessor based Drive, PLC based drive, Project on drives using standard software.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Conceptualize the basic drive system and analyse it for different types of loads.
   - Analyse the motor situation during starting and braking.
   - Develop control circuitry and devices for control of motor.

- Estimate the motor rating for different condition of load.
- Design the converter circuit for control purpose along with its different configuration.
- Use PLC and converter control to drive on the basis of energy efficiency.

6. Brief list of topics to be covered

- Definitions and Dynamics of Electric Drives
- Drive Features of Importance
- Static Control of Motors
- Estimation of Motors Rating
- Solid State Controlled Drives

Course Syllabi: UEE631: HVDC Transmission Systems (L : T : P :: 3 : 0 : 0)

1. **Course number and name**: UEE631: HVDC Transmission Systems

2. **Credits and contact hours**: 3.0 and 3

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Arrillaga, J., HVDC Transmission, IEE Press (2007).*
   - *Edwart, K., Direct Current Transmission (Vol. 1), John Wiley and Sons (2008).*
   - *Padiyar, K.R., HVDC Power Transmission System, New Age International (P) Limited, Publishers (2008).*
     Arrillaga, J. and Smith, B.C., AC to DC Power System Analysis, IEE Press (2008).

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

   DC power transmission technology: Introduction, Comparison of HVAC and HVDC transmission system, Applications of DC transmission, Description of DC transmission system, Configurations, Modern trends in DC transmission.
   Analysis of HVDC converters: Pulse number, Choice of converter configuration, Simplified analysis of Graetz circuit, Converter bridge characteristics, Characteristics of a twelve-pulse converter, Detailed analysis of converters with and without overlap.
   Converter and HVDC system control: General, Principles of DC link control, Converter control characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers.
   Converter faults and protection: Converter faults, Protection against over-currents, Over-voltages in a converter station, Surge arresters, Protection against over-voltages.
   Smoothing reactor and DC line: Introduction, Smoothing reactors, DC line, Transient over voltages in DC line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC transmission lines.
   Reactive power control: Reactive power requirements in steady state, Sources of reactive power, Static VAR systems, Reactive power control during transients, Harmonics and filters, Generation of harmonics, Design of AC filters, DC filters.
   Component models for the analysis of ac/dc systems: General, Converter model, Converter control, Modelling of DC network, Modelling of AC networks.
   Power flow analysis in AC/DC systems: General, Modelling of DC links, Solution of DC load flow, Discussion, Per unit system for DC quantities.

5. **Specific goals for the course**
   After the completion of the course, the students will be able to:
   - Choose intelligently AC and DC transmission systems for the dedicated application(s).
   - Identify the suitable two-level/multilevel configuration for high power converters.
   - Select the suitable protection method for various converter faults.
   - Identify suitable reactive power compensation method.
   - Decide the configuration for harmonic mitigation on both AC and DC sides..

6. Brief list of topics to be covered

- DC power transmission technology
- Analysis of HVDC converters
- Converter and HVDC system control
- Converter faults and protection
- Smoothing reactor and DC line
- Reactive power control
- Component models for the analysis of ac/dc systems
- Power flow analysis in AC/DC systems

Course Syllabi: UEE632: **Power Generation and Economics (L : T : P :: 3 : 0 : 0)**

1. **Course number and name**: UEE632: Power Generation and Economics

2. **Credits and contact hours**: 3.0 and 3

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Chakrabarti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Arora, S.C and Domkundawar, S., a course in Power Plant Engineering, DhanpatRai (2002).*
   - *Deshpande, M.V., Power Plant Engineering, Tata McGraw Hill (2004).*
   - *Gupta, B.R., Generation of Electrical Energy, S. Chand (1998).*
   - *Deshpande, M.V., Electrical Power System Design, McGraw Hill (2004).*
     Wood, A.J. and Wollenberg, B.F., Power Generation and Control, John Wiley (2004).

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Energy sources and their availability, Principle types of power plants, their special features and applications, Present status and future trends.

   Hydro Electric Power Plants: Essentials, Classifications, Hydroelectric survey, Rainfall run-off, Hydrograph, Flow duration curve, Mass curve, Storage capacity, Site selection, Plant layout, various components, Types of turbines, Governor and speed regulation, Pumped storage, Small scale hydro–electric plants (mini and micro).

   Thermal Power Plant: General developing trends, Essentials, Plant layout, Coal–its storage, Preparation, Handling, Feeding and burning, Cooling towers, Ash handling, Water treatment plant, High pressure boilers and steam turbines, Components of thermal power plant.

   Gas Turbine Power Plants: Field of use, Components, Plant layout, Comparison with steam power plants, combined steam and gas power plants.

   Nuclear Power Plant: Nuclear fuels, Nuclear energy, Main components of nuclear power plant, Nuclear reactors types and applications, Radiation shielding, Radioactive and waste disposal safety aspect.

   Non-Conventional Power Generation: Geothermal power plants, Electricity from biomass, Direct energy conversion systems (Solar and Wind), Thermo-electric conversion system, Fuel cells, Magneto-Hydro dynamic system.

   Cogeneration: Definition and scope, Cogeneration technologies, Allocation of costs, Sale of electricity and impact on cogeneration.

   Power Plant Economics: Cost of electrical energy, Selection of type of generation and generation equipment, Performance and operating characteristics of power plants, Economic scheduling principle, Load curves, Effect of load on power plant design, Load forecasting, electric tariffs, Peak load pricing.

5. **Specific goals for the course**

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

   - Apply knowledge of India's power scenario, power system structure and related agencies.
   - Explain about various types of power plants i.e., hydro, thermal, gas and nuclear.

- Harness power from conventional and renewable sources.
- Select the methods and size of plant generating power for overall economy.
- Decide the tariff structure for different type of users.

6. Brief list of topics to be covered

- Hydro Electric Power Plants
- Thermal Power Plant
- Gas Turbine Power Plants
- Nuclear Power Plant
- Non-Conventional Power Generation
- Cogeneration
- Power Plant Economics

Course Syllabi: UEE633: Generalized Theory of Electrical Machines (L : T : P :: 3 : 0 : 0)

1. **Course number and name**: UEE633: Generalized Theory of Electrical Machines

2. **Credits and contact hours**: 3.0 and 3

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Kraus, P.C., Analysis of Electric Machine, McGrawHill (2000).*
   - *Bimbhra, P.S., Generalized Theory of Electric Machines, Khanna Publishers (2006).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Common essential constructional and operational features of electrical machines, basic two pole machine representation of different types of electrical machines, Kron's primitive machine, Voltage equations in matrix form for Kron's primitive machine, Impedance matrix.
   Linear Transformations in Machines: Reference frame theory, 3-phase to 2-phase transformation, Transformation from rotating axes to stationary axes, Physical concept of park's transformation, Volt-ampere and torque equations, Space vector concept.
   DC Machine: Transfer function for DC machine (Shunt, Series and compound), Linearization technique, Analysis under motoring and generating made, Dynamic analysis.
   Synchronous Machine: General machine equation in different frame, Dynamic analysis, Power angle characteristics, Phases diagram for cylindrical rotor and salient pole machine, Electromagnetic and reluctance torque, Electric braking of synchronous machine.
   3-phase Induction Machine: Performance equations in different rotating frames, Equivalent circuit, Different inductance, Effect of voltage and frequency on the performance, Braking, Unbalance operations.
   Advanced Machines: 1-phase synchronous motor, 2-phase servomotor, AC tachometers, Switched reluctance motor, Brushless DC machine.

5. **Specific goals for the course**

   After the completion of the course, the students will be able to:
   - Express the revolving field and reference frame theory.
   - Develop mathematical model of three-phase AC machines and parameters in different reference frame.
   - Simulate the transient performance of three-phase ac machines in different reference frames.
   - Investigate the transient performance of different DC machines.
   - Select special purpose small machines for different applications.

6. **Brief list of topics to be covered**
   - Linear Transformations in Machines
   - DC Machine

- Synchronous Machine
- 3-phase Induction Machine
- Advanced Machines

Course Syllabi: UEE693: Capstone Project Start (L : T : P :: 0 : 0 : 2)

1. **Course number and name**: UEE693: Capstone Project

2. **Specific course information**

   Course Objective: To facilitate the students learn and apply an engineering design process in electrical engineering, including project resource management. As a part of a team, the students will make a project, that emphasizes, hands-on experience, and integrates analytical and design skills. The idea is to provide an opportunity to the students to apply what they have learned throughout the course of graduate program by undertaking a specific problem.

   Course Description: Capstone Project is increasingly interdisciplinary, and requires students to function on multidisciplinary teams. It is the process of devising a system, component or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. It typically includes both analysis and synthesis performed in an iterative cycle. Thus, students should experience some iterative design in the curriculum. As part of their design experience, students have an opportunity to define a problem, determine the problem scope and to list design objectives. The project must also demonstrate that students have adequate exposure to design, as defined, in engineering contexts. Engineering standards and realistic constraints are critical in engineering design. The program must clearly demonstrate where standards and constraints are taught and how they are integrated into the design component of the project. Each group will have 4-5 students. Each group should select their team leader and maintain daily diary. Each Group will work under mentorship of a Faculty supervisor. Each group must meet the assigned supervisor (2hrs slot/week) till the end of the semester (record of attendance will be maintained), as per the time slot which will be provided to them by the respective supervisor. This is mandatory requirement for the fulfilment of the attendance as well as the successful completion of the project. The faculty supervisor of the project will continuously assess the progress of the works of the assigned groups. Some part of the analysis and design of the system will be done in the first section of project in semester VI. The second section would comprise of completion of the project in semester VII in which each team will have to submit a detailed report of the project along with a poster.

3. **Specific goals for the course**

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

   - To identify design goals and analyze possible approaches to meet given specifications with realistic engineering constraints.
   - To design an electrical engineering project implementing an integrated design approach applying knowledge accrued in various professional courses.
   - To perform simulations and incorporate appropriate adaptations using iterative synthesis.
   - To use modern engineering hardware and software tools.
   - To work amicably as a member of an engineering design team.
   - To improve technical documentation and presentation skills.

Course Syllabi: UEE502: High Voltage Engineering (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UEE502: High Voltage Engineering

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Chakrabarti, A., Soni, M.L., Gupta, P.V. and Bhatnagar, U.S., a Text Book on Power System Engineering, DhanpatRai (2008).*
- *Wadhwa, C.L., Electrical Power Systems, New Age International (P) Limited, Publishers (2008).*
- *Gupta, B.R., Power System Analysis and Design, S. Chand (2009).*
- *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw–Hill (2007).*
- *Pabla, A.S., Electric Power Distribution, McGraw Hill (2008).*
- *Stevenson, W.D., Power System Analysis, McGraw–Hill (2007).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Introduction: Introduction to AC and DC impulse voltages and their use, Problems in dealing with high voltages.

Breakdown in Gases: Elementary ideas on ionization by electron collision, Townsend mechanism, Townsend first and second ionization coefficients, Paschen law, breakdown in non-uniform fields and corona discharges, vacuum breakdown mechanisms, breakdown in liquids, fundamentals of insulating oils, conduction and breakdown in pure and commercial liquids.

Breakdown in Solids: Fundamentals of solid insulating materials intrinsic, electromechanical and thermal breakdown, breakdown in simple and composite dielectrics, types of insulating materials, temperature classification, factor affecting dielectric strength, insulation design of rotating machines, transformers, transmission lines, Switch gear, etc.

Generation of High Voltages: Generation of high voltages, testing transformers in cascade, series resonant circuits and their advantages, half and full wave rectifier circuits, voltage doubler and cascade circuits, electrostatic generator, characteristics parameters of impulse voltages, single stage impulse generator circuits, multistage impulse generation circuits.

Measurement of High Voltages: Measurement of direct, alternating and impulse voltages by electrostatic voltmeters, sphere gap, uniform field gap, ammeter in series with high voltage resistors and voltage divider

Non-Destructive High Voltage Tests: Loss in a dielectric and its measurement, dielectric loss measurement by Schering bridge, partial discharges at alternating voltages, external and internal partial discharges and discharge measurements.

Laboratory work: Voltage measurement by sphere gap and Chubb and Fortesque methods, Insulation resistance measurement using Meggar, Experimental setup for standard lightning wave, Efficiency and peak voltage measurement by sphere gap impulse voltage time curves, Breakdown voltage, Conductivity and dissipation factor measurement with Schering bridge, partial discharge measurements.

5. **Specific goals for the course**

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

   - Conceptualize the idea of high voltage and safety measures involved.
   - Analyse the breakdown mechanism of solids, liquids and gases.
   - Analyse and calculate the circuit parameters involved in generation of high voltages.
   - Measure direct, alternating and impulse high voltage signals.
   - Measure the dielectric loss and partial discharge involved in non-destructive high voltage tests.

6. **Brief list of topics to be covered**

   - Breakdown in Gases
   - Breakdown in Solids
   - Generation of High Voltages
   - Measurement of High Voltages
   - Non-Destructive High Voltage Tests

Course Syllabi: UEE604: Flexible AC Transmission Systems (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEE604: Flexible AC Transmission Systems

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Hingorani, N.G. and Gyragyi,L., Understanding FACTS :Concepts and Technology of Flexible AC Transmission System, Standard Publishers and Distributors (2005).*
- *Sang, Y.H. and John, A.T., Flexible AC Transmission Systems, IEEE Press (2006).*
- *Ghosh,A. and Ledwich,G., Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers (2005).*
- *Mathur, R.M. and Verma, R.K., Thyristor Based FACTS Controllers for Electrical Transmission Systems, IEEE Press (2002).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Power Transmission control: Fundamentals of AC power transmission, Transmission problems and needs, Overview of stability, the emergence of FACTS, FACTS controller and consideration.

Static power convertor: Review of Power Electronics fundamentals: Static power convertor structures, AC controller based structure, DC link convertor topologies, Convertor output and harmonic control.

Shunt Compensation: Shunt SVC principles, Configuration and control, STATCOM, Configuration applications.

Series Compensation: Fundamental of series compensation, Principle of operation, Application of TCSC for different problems of power system, TCSC lay out, SSSC principle of operation.

Phase Shifter: Principle of operation, Steady state model of static phase shifter, Operating characteristics of SPS, Power current configuration of SPS application.

Unified Power Flow Controllers: Basic operating principles and characteristics, Control UPFC installation applications, UPFC model for power flow studies.

5. **Specific goals for the course**

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

- Describe the converter configuration for different power systems applications such as HVDC, FACTS etc.
- Evaluate the converters, harmonics on AC and DC side and filtering.
- Classify various compensators suited for various power system purposes.
- Analyze power system behaviour with different shunt compensators.
- Appraise series compensated power system behaviour with different series compensators.
- Analyse system behaviour with hybrid shunt-series compensators.

6. Brief list of topics to be covered

- Power Transmission control
- Static power convertor
- Shunt Compensation
- Series Compensation
- Phase Shifter& Unified power flow controller

Course Syllabi: UEE702: Intelligent Techniques in Electrical Engineering (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UEE702: Intelligent Techniques in Electrical Engineering

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

   Text Books / Reference Books
   - *Lin, C., Lee, G., Neural Fuzzy Systems, Prentice Hall International Inc. (2000).*
   - *Rajashekran, S. and Vijaylaksmi Pai, G.A., Neural Networks, Fuzzy Logic and Genetic Algorithm Systhesis and Applications, PrenticeHall of India Private Limited (2004).*
   - *Zurda, J.M., C++ Neural Networks and Fuzzy Logics, BPS Publication (2001).*
   - *Kosko, B., Neural Networks and Fuzzy Systems: a Dynamical systems Approach to Machine Intelligence, Prentice Hall of India Private Limited (1992).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**
   a. Brief description of the content of the course (catalog description)

Introduction: Concept of artificial intelligence, Introduction to classical problem solving methods and heuristic search techniques.
Fuzzy Systems: Fuzzy sets, Operation on fuzzy sets, Fuzzy relations, measures, Fuzzy logic, Fuzzy logic controller (FLC).
Artificial Neural Networks: Fundamental concepts, Basic models, Learning rules, Single layer and multi-layer feed-forward and feedback networks, Supervised and unsupervised methods of training, Recurrent networks, Modular network.
Genetic Algorithm: Basic principle, Evolution of genetic algorithm, Hybrid genetic algorithm, trends in stochastic search.
Hybrid Systems: Integrated hybrid systems such as neuro-fuzzy, fuzzy-neuro.
Applications: Short term and long term load forecasting, Identification, Classification, Fault location and fault diagnosis, Economic load dispatch, DC/AC four quadrant drive control.
Laboratory work: Training algorithms of neural networks and fuzzy logic, Implementation of fuzzy logic, Neuralnetworks and genetic algorithms on various applications, Use of MATLAB tools of fuzzy logic and NN.

5. **Specific goals for the course**
   After the completion of the course, the students will be able to:
   - Examine the fuzzy system and implement fuzzy controllers for control and classification.
   - Explain neural networks behaviour and use them for classification, control system and optimization problem.
   - Obtain the optimum solution of well formulated optimisation problem using evolutionary approach.
   - Formulate hybrid intelligent algorithms for typical electrical application.

6. **Brief list of topics to be covered**
   - Fuzzy Systems

- Artificial Neural Networks
- Artificial Neural Networks
- Genetic Algorithm
- Hybrid Systems
- Applications

Course Syllabi: UEE804: Operation and Control of Power Systems (L : T : P :: 3 : 1 : 2)

1. **Course number and name**: UEE804: Operation and Control of Power Systems

2. **Credits and contact hours**: 4.5 and 6

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Chakraborti A., Soni,M.L., Gupta,P.V. and Bhatnagar,U.S., a Text Book on Power System Engineering, Dhanpat Rai and Co. (P) Ltd. (2008).*
- *Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw Hill (2007).*
- *Stevenson, W.D., Power System Analysis, McGraw Hill (2007).*
- *Kothari, D.P., Dhillon, J.S., Power System Optimization, PHI Learning (2010).*
- *Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, Power Generation, Operation and Control, Wiley-Interscience (2013).*
- *Kimbark, E. W., Power System Stability, Volumes-I, IEEE Press (1995).*
- *Jizhong Z., Optimization of power system operation, Edition Wiley (1996).*
- *Elgerd, O. Electric Energy Systems Theory, McGraw Hill Education Private Limited (2001).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Economic Operation of Power Systems: Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, Minimum and maximum power generation limits.

Economic Dispatch: Economic dispatch problem with and without transmission line losses, Unit Commitment, methods for their solutions.

Hydrothermal Co-ordination: Hydro-scheduling, Plant models, Scheduling problems, Hydrothermal scheduling problems and its approach.

Power System Control: Ideas of load frequency and voltage control, Reactive power control, Block diagrams of P-f and Q-V controllers, ALFC control, Static and dynamic performance characteristics of ALFC and AVR controllers, Excitation systems model, concept of area and Tie-line operations.

Power System Security: Factors affecting security, Contingency analysis, Network sensitivity, correcting the generation dispatch by using sensitivity method and linear programming.

Small Scale Stability Analysis: d-q model of generator, State space representation, Eigen value and participation factor analysis.

Voltage Stability: Basic concepts, Voltage collapse, P-V and Q-V curves, Impact of load, Static and dynamic analysis of voltage stability, Prevention of voltage collapse.

Laboratory Work: Simulation of thermal scheduling with and without losses, Unit commitment by dynamic programming, simulation of hydro-thermal scheduling by gradient

method, Stability analysis of single area frequency control, Bias control of two area system and AVR.

5. **Specific goals for the course**

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

- Develop small scale model of alternator, excitation and governing systems.
- Decide the scheduling of thermal units and hydro-thermal units for overall economy.
- Design and apply control for frequency and voltage of power system represented by multi area.
- Comprehend power system security and contingency.
- Computation of small scale and voltage stability**.**

6. **Brief list of topics to be covered**

- Economic Operation of Power Systems
- Economic Dispatch
- Hydrothermal Co-ordination
- Power System Control
- Power System Security
- Small Scale Stability Analysis
- Voltage Stability

Course Syllabi: UEE524: Power Quality Monitoring and Conditioning (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEE524: Transmission and Distribution of Power

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Kennedy, B., Power Quality Primer, McGrawHill (2000).*
- *Beaty, H. and Santoso,S., Electrical Power System Quality, McGrawHill (2002).*
- *Bollen, M.H.J., Power Quality Problems: Voltage Sag and Interruptions, IEEE Press (2007).*

a. Other supplemental materials
   - Nil

4. **Specific course information**

a. Brief description of the content of the course (catalog description)

Overview and definition of power quality (PQ): Sources of pollution and regulations, Power quality problems, Rapid voltage fluctuations voltage unbalance, Voltage dips and voltage swells, Short duration outages.

Definitions Voltage sag analysis and mitigation: Sag caused by motor starting, Sag caused by utility fault clearing, Sag mitigation, Sag magnitude and duration calculations, RMS voltage, Calculation in 1-phase systems, Equipment performance in presence of sag, Computers, AC and DC drives.

Harmonics: Effects-within the power system, Interference with communication harmonic measurements, Harmonic elimination.

Harmonic distortion: Power Overview system harmonics, Harmonic analysis, Harmonic sources-the static converters, Transformer magnetization and non-linearities, Rotating machines, Arc furnaces, Fluorescent lighting, Total harmonic distortion, rms and average value calculations, Effects of harmonic distortion.

Principles for controlling harmonics: Locating sources of harmonics, Passive and active filters, Harmonic filter design.

Monitoring power quality: Monitoring essentials, Power quality measuring equipment, Current industry trends.

Power Conditioning: Electric power conditioning, Active and passive filters.
IEEE, IEC, ANSI standards, Power acceptability curves, Various standards.

5. **Specific goals for the course**

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

- Reliably identify the sources of various power quality problems.
- Explain about causes of harmonic and its distortion effect.
- Estimate the impact of various power quality problems on appliances.
- Educate the harmful effects of poor power quality and harmonics.
- Decide the compensators and filters to keep the power quality indices within the standards.

6. Brief list of topics to be covered

- Overview and definition of power quality
- Definitions Voltage sag analysis and mitigation
- Harmonics
- Harmonic distortion
- Principles for controlling harmonics
- Monitoring power quality
- Power Conditioning

Course Syllabi: UEE841: Industrial Electronics (L : T : P :: 3 : 1 : 0)

1. Course number and name: UEE841: Industrial Electronics

2. Credits and contact hours: 3.5 and 4

3. Text book, title, author, and year

Text Books / Reference Books

- *Dubey, G.K., Power Semiconductor Controlled Drives, Prentice Hall inc. (1989).*
- *Paul, B., Industrial Electronic and Control, Prentice Hall of India Private Limited (2004).*
- *J.M.D. Murphy, F.G. Turnbull, Power Electronic Control of Ac Motors, Pergamon (1990).*
- *Sen, P.C., Thyristor DC Drives, John Wiley and Sons (1981).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Conventional DC and AC Traction: Electric traction services, Nature of traction load, Coefficient of adhesion, Load sharing between traction motors, Main line and suburban train configurations, Calculation of traction drive rating and energy consumption. Important features of traction drives, Conventional DC and AC traction drives, Diesel electric traction.

Static converters for Traction: Semi-conductor converter controlled drive for AC traction, Semiconductor chopper controlled DC traction.

Illumination: Nature of light, Basic laws of illumination, Light sources and their characteristics, Light production by excitation and ionization, Incandescence and fluorescence, Different types of lamps, Their construction, Operation and characteristics, Applications, Latest light sources, Design of illumination systems.

Electric Heating: Introduction to electric heating, Advantages of electric heating, Resistance heating, Temperature control of furnaces, Induction and dielectric heating.

Power Supplies: Performance parameters of power supplies, Comparison of rectifier circuits, Filters, Regulated power supplies, Switching regulators, Switch mode converter.

Power factor Control: Static reactive power compensation, Shunt reactive power compensator, Application of static SCR controlled shunt compensators for load compensation, Power factor improvement and harmonic control of converter fed systems, Methods employing natural and forced commutation schemes, Methods of implementation of forced commutation.

Motor Control: Voltage control at constant frequency, PWM control, Synchronous tap changer, Phase control of DC motor, Servomechanism, PLL control of a DC motor.

5. Specific goals for the course

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

- Simulate and analyse the semiconductor controlled ac and DC drive system.
- Design and develop an illumination system for domestic, industry and commercial sites.
- Design an electric heating system for industrial purposes.
- Equip the skill to design and develop a regulated power supply.

- Simulate and analyse the series and shunt compensators for power factor improvement in drive system.

6. Brief list of topics to be covered

- Conventional dc and ac Traction
- Static converters for Traction
- Illumination
- Electric Heating
- Power Supplies
- Power factor Control
- Motor Control

Course Syllabi: UEE521: Electric Machine Design (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEE521: Electric Machine Design

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Ramamoorty, M., Computer Aided Design of Electrical Equipment, Eastern Press Private Limited (1989).*
- *A.K. Sawhney, a Course in Electrical Machine Design, DhanpatRai& CO. (2013).*
- *Say, M.G., Design and Performance of Machines, CBS Publications (1981).*
- *Hamdi, E.S., Design of Small Electrical Machine, John Wiley and Sons (1994).*
- *Smith, S.P. and Say, M.G., Electrical Engineering Design Manual, Chapman and Hall (1984).*
- *Walker, J.H., Large AC Machines: Performance and Operation, BHEL (1997).*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Introduction: Design of Machines, Factors, limitations, Modern trends. Materials: Conducting, magnetic and insulating materials.

Magnetic Circuits: Calculations of mmf for air gap and teeth, real and apparent flux densities, iron losses, field form, leakage flux, specific permanence.

Heating and Cooling: Modes of heat dissipation, Temperature gradients, types of enclosures, types of ventilation, conventional and direct cooling, amount of coolants used, Ratings.

Armature Windings: Windings for DC and AC machines and their layout.

Design of Transformers: Output equation, Types of transformer windings, design of core and windings and cooling tank, performance calculations.

Concepts and Constraints in Design of Rotating Machines: Specific loading, output equation and output co-efficient, effects of variation of linear dimension.

Skeleton Design of Rotating Machines: Calculation of D and L for DC, induction and synchronous machines, length of air gap, design of field coils for DC and synchronous machines, selection of rotor slots of squirrel cage induction motors, design of bars and ends, design of rotor for wound rotor for induction motors, design of commutator and inter poles for DC machines.

Computer Aided Design of Electrical Machines: Analysis and synthesis approaches, design algorithms, Introduction to optimization techniques, Implementing computer program for design of three phase induction motor.

5. Specific goals for the course

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

- Design DC machines.
- Design transformers with reduced losses.
- Calculate the losses and efficiency in the machines.
- Analyze and synthesis of computer aided design of electrical machines.

- Design three phase induction motor.

6. Brief list of topics to be covered

- Magnetic Circuits
- Heating and Cooling
- Armature Windings
- Design of Transformers
- Concepts and Constraints in Design of Rotating Machines
- Skeleton Design of Rotating Machines
- Computer Aided Design of Electrical Machines

Course Syllabi: UEE850: Smart Grid (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEE850: Smart Grid

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *INIEWSKI , Smart Grid Infrastructure and Networking, McGraw-Hill Education India Pvt.Ltd (2012), 1st Edition.*
   - *James Momoh, Smart Grid: Fundamentals of Design and Analysis, IEEE Computer Society Press (2012).*
   - *EkanayakeJ.,Jenkins N., Liyanage K., Wu, J., Yokoyama A., Smart Grid: Technology and applications, Wiley Publications.*
   - *Momoh J., Smart Grid: Fundamentals of design and analysis, John Wiley & Sons. Flick T., Morehouse J., Securing the smart grid: Next generation power grid security, paperback).*

   a. Other supplemental materials
      - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Communication Technologies for Power System: Fiber Optical Networks, WAN based on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee.

Information System for Control Centers (ICCS): ICCS Configuration, ICCS communication Network, ICCS Time Synchronization, E-Commerce of Electricity, GIS, GPS.

Integration, Control and Operation of Distributed Generation: Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

Monitoring the smart grid: Load dispatch centers, wide-area monitoring system (WAMS), PMU; Smart sensors/telemetry, advanced metering infrastructure (AMI);smart metering; smart grid system monitoring; communication infrastructure and technologies; self-healing.

Micro grid: Integration of distributed energy sources; concept, operation, control and protection of Micro grid**.**

Hybrid Power Systems: Integration of conventional and non-conventional energy sources.

5. Specific goals for the course

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

- Explain various aspects of the smart grid, including, Technologies, Components, Architectures and Applications.
- Explain communication infrastructure of smart grid.
- Explain various integration aspects of conventional and non-conventional energy sources.
- Explain distributed generation coordination including monitoring of smart grid using modern communication infrastructure.
- Analyze Microgrid as a hybrid power system with advantages and challenges in future.

6. Brief list of topics to be covered

- Communication Technologies for Power System
- Information System for Control Centers (ICCS)
- Integration, Control and Operation of Distributed Generation
- Monitoring the smart grid
- Micro grid
- Hybrid Power Systems

Course Syllabi: UEI841: Advanced Control Systems (L : T : P :: 3 : 1 : 0)

1. **Course number and name**: UEI841: Advanced Control Systems

2. **Credits and contact hours**: 3.5 and 4

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Slotine& Li, Applied Non-Linear Control,* Englewood Cliffs, NJ: Prentice-Hall, (1991).
   - *Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited (2003).*
   - *Ogata, K., Discrete-time Control Systems, Pearson Education (2005).*

   a. Other supplemental materials
   - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Nonlinear Control Systems: Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.

   Optimal Control Theory: Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin's optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle.

   z-Plane Analysis of Discrete-Time Control Systems: Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.

   Design of Discrete-time Control Systems: Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequency-response method.

   State-Space Analysis: Introduction, State-space representations of discrete-time systems, Solving discrete-time state-space equations, Pulse transfer function matrix, Discretization of continuous time state space equations, Lyapunov stability analysis, Controllability and Observability, Design via pole placement, State observer design.

5. **Specific goals for the course**

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

   - Demonstrate non-linear system behavior by phase plane and describing function methods.
   - Perform the stability analysis nonlinear systems by lyapunov method develop design skills in optimal control problems.
   - Derive discrete-time mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
   - Predict and analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
   - Acquire knowledge of state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.

6. Brief list of topics to be covered

- Nonlinear control system
- State space analysis
- Optimal control theory
- Discrete time control system

Course Syllabi: UEE793: Capstone Project (L : T : P :: 0 : 0 : 2)

1. **Course number and name**: UEE793: Capstone Project

2. **Credits**: 8.0

3. **Specific course information**

   Course Objective: To facilitate the students learn and apply an engineering design process in electrical engineering, including project resource management. As a part of a team, the students will make a project, that emphasizes, hands-on experience, and integrates analytical and design skills. The idea is to provide an opportunity to the students to apply what they have learned throughout the course of graduate program by undertaking a specific problem.

   Course Description: Capstone Project is increasingly interdisciplinary, and requires students to function on multidisciplinary teams. It is the process of devising a system, component or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs. It typically includes both analysis and synthesis performed in an iterative cycle. Thus, students should experience some iterative design in the curriculum. As part of their design experience, students have an opportunity to define a problem, determine the problem scope and to list design objectives. The project must also demonstrate that students have adequate exposure to design, as defined, in engineering contexts. Engineering standards and realistic constraints are critical in engineering design. The program must clearly demonstrate where standards and constraints are taught and how they are integrated into the design component of the project. Each group will have 4-5 students. Each group should select their team leader and maintain daily diary. Each Group will work under mentorship of a Faculty supervisor. Each group must meet the assigned supervisor (2hrs slot/week) till the end of the semester (record of attendance will be maintained), as per the time slot which will be provided to them by the respective supervisor. This is mandatory requirement for the fulfilment of the attendance as well as the successful completion of the project. The faculty supervisor of the project will continuously assess the progress of the works of the assigned groups. Some part of the analysis and design of the system will be done in the first section of project in semester VI. The second section would comprise of completion of the project in semester VII in which each team will have to submit a detailed report of the project along with a poster.

4. **Specific goals for the course**

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

   - To identify design goals and analyze possible approaches to meet given specifications with realistic engineering constraints.
   - To design an electrical engineering project implementing an integrated design approach applying knowledge accrued in various professional courses.
   - To perform simulations and incorporate appropriate adaptations using iterative synthesis.
   - To use modern engineering hardware and software tools.
   - To work amicably as a member of an engineering design team.
   - To improve technical documentation and presentation skills.

Course Syllabi: UEE891: Project (L : T : P :: 0 : 0 : 0)

1. **Course number and name**: UEE891: Project

2. **Credits**: 20.0

3. **Specific course information**
   Course Objectives

   The project semester is aimed at developing the undergraduate education programme in Electrical Engineering to include a practical training in a professional engineering set up (a company, top educational institution, research institute etc.) hereafter referred to as host "organization" as deemed appropriate. The participating organizations are selected that are either already visiting Thapar University for placement or are forming new relationships of mutual benefit. The project semester gives the student the opportunity to translate engineering theory into practice in a professional engineering environment. The technical activity in the project semester should be related to both the student's engineering studies and to the host organization's activities and it should constitute a significant body of engineering work at the appropriate level. It should involve tasks and methods that are more appropriately completed in a professional engineering environment and should, where possible, make use of human and technology resources provided by the organization. It consolidates the student's prior learning and provides a context for later research studies. The student remains a full time registered student at Thapar University during the project semester and this activity is therefore wholly distinct from any industrial interactions which may occur over vacation periods.

   Assessment Details

   Each student is assigned a faculty supervisor who is responsible for managing and assessment of the project semester. The faculty supervisor monitors the student's progress in a semester and interacts with the industry mentor during his/her visit to the host organization twice. This includes a Reflective Diary which is updated throughout the project semester, an Interim Project Report, a Final Report with Learning Agreement/Outcomes and a Final Presentation & Viva which involves the faculty Supervisor and some other members from the department. The mentor from the host organization is asked to provide his assessment on the designated form. The faculty supervisor is responsible for managing and performing the assessment of the project semester experience.

4. **Specific goals for the course**
   After completion of project semester, the students will be able to:
   - Acquire knowledge and experience of software and hardware practices in the area of project.
   - Carry out design calculations and implementations in the area of project.
   - Associate with the implementation of the project requiring individual and teamwork skills.
   - Communicate their work effectively through writing and presentation.
   - Demonstrate the knowledge of professional responsibilities and respect for ethics.

Course Syllabi: UEE806: Alternate Sources of Energy (L : T : P :: 3 : 0 : 2)

1. **Course number and name**: UEE806: Alternate Sources of Energy

2. **Credits and contact hours**: 4.0 and 5

3. **Text book, title, author, and year**

   Text Books / Reference Books

   - *Rai, G.D., Non Conventional Energy Sources, Khanna Publishers (2005).*
   - *Rao, S. and Parulekar, B.B., Energy Technology: Non Conventional, Renewable and Conventional, Khanna Publishers (2005).*
   - *Wadhwa, C.L., Generation, Distribution and Utilization of Electric Energy, New Age International (P) Limited, Publishers (2007).*
   - *Simon , Christopher A., Alternate Source of Energy, Rowman and LittleField Publishers Inc.(2007).*
   - *Venikov, V.A. and Putyain, E.V., Introduction to Energy Technology, Mir Publishers (1990).*

   a. Other supplemental materials
      - Nil

4. **Specific course information**

   a. Brief description of the content of the course (catalog description)

   Introduction: Global and national energy scenarios, concept of energy services, patterns of energy supply, energy resource availability, cultural, economic and national security aspects of energy consumption, forms and characteristics of renewable energy sources, energy classification, source and utilization, thermodynamic power cycles and binary cycles.
   Solar Energy: Solar radiation, flat plate collectors, solar concentration, thermal applications of solar energy, photovoltaic technology and applications, energy storage.
   Biomass Energy: Energy from biomass, thermo chemical, biochemical conversion to fuels, biogas and its applications.
   Wind Energy: Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, electricity generation and water pumping, Micro/Mini hydro power system, water pumping and conversion to electricity, hydraulic pump.
   Other Alternate Sources: Ocean thermal energy conversion, Geothermal, Tidal, Wave energy, MHD, Fuel cells, environmental issues of energy services.
   Stand alone generating units: Synchronous generator and induction generator, operation and characteristics, voltage regulation, lateral aspects of renewable energy technologies and systems.

5. **Specific goals for the course**

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

   - Explain the basic renewable energy sources like solar, wind ,biomass etc.
   - Explain various advantages and disadvantages of renewable energy sources.
   - Familiarization with different standalone, off grid energy sources.
   - Explain different technology associate with solar, wind, biomass and other renewable energy sources.
   - Describe the working of micro/mini hydropower system.

6. **Brief list of topics to be covered**
    - Solar Energy
    - Biomass Energy
    - Wind Energy
    - Other Alternate Sources
    - Stand alone generating units

Course Syllabi: UEI805: Environmental Instrumentation (L : T : P :: 3 : 0 : 0)

1. **Course number and name**: UEI805: Environmental Instrumentation

2. **Credits and contact hours**: 3.0 and 3

3. **Text book, title, author, and year**

Text Books / Reference Books

- *Bhatia, H.S., a Text Book in Environmental Pollution and control, Galgotia Publication (1998).*
- *Dhameja, S.K., Environmental Engineering and Management, S.K Kataria (2000).*
- *Rao, M.N. and Rao, H.V., Air Pollution, Tata McGraw Hill (2004).*
- *Rao. C.S., Environmental Pollution Control, New Age International (P) Limited, Publishers (2006) 2nd ed*

a. Other supplemental materials
   - Nil

4. Specific course information

a. Brief description of the content of the course (catalog description)

Air Pollution: Impact of man of the environment: An overview, Air pollution sources and effects, Metrological aspect of air pollutant dispersion, Air pollution sampling and measurement, Air pollution control methods and equipment, Air sampling techniques, soil pollution and its effects, Gas analyzer, Gas chromatography, Control of specific gaseous pollutants, Measurement of automobile pollution, Smoke level meter, CO/HC analyzer.

Water pollution: Sources and classification of water pollution, Waste water sampling and analysis, Waste water sampling techniques and analyzers: Gravimetric, Volumetric, Calometric, Potentiometric, Flame photometry, Atomic absorption spectroscopy, Ion chromatography, Instruments used in waste water treatment and control, Latest methods of waste water treatment plants.

Pollution Management: Management of radioactive pollutants, Noise level measurement techniques, Noise pollution and its effects, Solid waste management techniques, social and political involvement in the pollution management system

5. Specific goals for the course

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

- explain sources and effects of air and water pollutants
- explain air pollution sampling and measurement techniques
- explain water sampling and analysis techniques
- explain solid waste management and noise level measurement techniques

6. Brief list of topics to be covered

- Air pollution
- Water pollution
- Pollution management