SEMESTER – I

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	100110	Engineering Physics	3	0	0	3	70	30
2.	100102	Engineering Mathematics-I	3	1	0	4	70	30
3.	100111	Programming for Problem Solving	3	0	0	3	70	30
4.	100106	Basic Electrical Engineering	3	0	0	3	70	30
5.	100112	Workshop Practices	2	0	0	2	70	30
6.	100110P	Engineering Physics Lab	0	0	2	1	30	20
7.	100111P	Programming for Problem Solving Lab	0	0	2	1	30	20
8.	100106P	Basic Electrical Engineering Lab	0	0	2	1	30	20
9.	100112P	Workshop Practices Lab	0	0	2	1	30	20
10.	100115P	Swachha Bharat Mission	0	0	2	1	30	20
					TOTAL	20	750	

SEMESTER – II

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	100215	Engineering Chemistry	3	0	0	3	70	30
2.	100202	Engineering Mathematics-II	3	1	0	4	70	30
3.	100216	Communicative English	3	0	0	3	70	30
4.	100209	Basic Electronics	3	0	0	3	70	30
5.	100217	Engineering Graphics and Design	1	0	0	1	70	30
6.	100215P	Engineering Chemistry Lab	0	0	2	1	30	20
7.	100216P	Communicative English Lab	0	0	2	1	30	20
8.	100209P	Basic Electronics Lab	0	0	2	1	30	20
9.	100217P	Engineering Graphics and Design Lab	0	0	4	2	30	20
10.	100220P	Sports/Yoga/NCC/NSS	0	0	2	1	30	20
					TOTAL	20	750	

SEMESTER-III

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	110301	Electrical Circuit Analysis	3	1	0	4	70	30
2.	110302	Digital Electronics	3	1	0	4	70	30
3.	110303	Engineering Mathematics-III (PDE, Prob/stat)	3	1	0	4	70	30
4.	110304	Electromagnetic Field Theory	3	1	0	4	70	30
5.	110305	Signals and Systems	3	0	0	3	70	30
6.	110306	Universal Human Values	3	0	0	3	70	30
7.	110307	Indian Knowledge System	3	0	0	0	-	-
8.	110301P	Electrical Circuit Analysis Lab	0	0	2	1	30	20
9.	110302P	Digital Electronics Lab	0	0	2	1	30	20
10.	110308	Internship – I	02 Weeks			2	30	20
					TOTAL	26	750	

SEMESTER-IV

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	110401	Analog Electronics	3	1	0	4	70	30
2.	110402	Digital Signal Processing	3	1	0	4	70	30
3.	110403	Electrical Machine-I	3	1	0	4	70	30
4.	110404	Microprocessor and Microcontroller	3	1	0	4	70	30
5.	110405	Engineering Mechanics	3	0	0	3	70	30
6.	110401P	Analog Electronics Lab	0	0	2	1	30	20
7.	110402P	Digital Signal Processing Lab	0	0	2	1	30	20
8.	110403P	Electrical Machine-I Lab	0	0	2	1	30	20
9.	110404P	Microprocessor and Microcontroller Lab	0	0	2	1	30	20
10.	110406	NPTEL-I (Open Course)	12 weeks			3	75	25
					TOTAL	26	800	

SEMESTER V

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	110501	Power System – I	3	1	0	4	70	30
2.	110502	Electrical Machine-II	3	1	0	4	70	30
3.	110503	Control System	3	1	0	4	70	30
4.	110504	Analog and Digital Communication System	3	0	0	3	70	30
5.	1105XX	Open Electives Course-I	3	0	0	3	70	30
6.	110506	Indian Constitution	3	0	0	0	-	-
7.	110501P	Power System -I Lab	0	0	2	1	30	20
8.	110502P	Electrical Machine-II Lab	0	0	2	1	30	20
9.	110503P	Control System Lab	0	0	2	1	30	20
10.	110504P	Analog and Digital Communication System Lab	0	0	2	1	30	20
11.	110505	Internship- II	4 weeks			4	30	20
					TOTAL	26	750	

SEMESTER VI

Sl. No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	110601	Power Electronics	3	1	0	4	70	30
2.	110602	Power System-II	3	1	0	4	70	30
3.	110603	Electrical and Electronics Measurement	3	0	0	3	70	30
4.	110604	Entrepreneurship and Startups	3	0	0	3	70	30
5.	1106XX	Program Elective Course-I	3	0	0	3	70	30
6.	1106XX	Open Electives Course-II	3	0	0	3	70	30
7.	110601P	Power Electronics Lab	0	0	2	1	30	20
8.	110602P	Power System-II Lab	0	0	2	1	30	20

9.	110603P	Electrical and Electronics Measurement Lab	0	0	2	1	30	20
10.	110605	NPTEL-II (Core Course)	12 weeks			3	75	25
					TOTAL	26	850	

SEMESTER VII

Sl. No.	Course Code	Course Title	Hours per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	1107XX	Program Elective Course-II	3	0	0	3	70	30
2.	1107XX	Program Elective Course -III	3	0	0	3	70	30
3.	1107XX	Open Elective Course-III	3	0	0	3	70	30
4.	1107XX	Open Elective Course-IV	3	0	0	3	70	30
5.	110701	Internship - III	6 weeks			6	30	20
					TOTAL	18	450	

SEMESTER VIII

Sl. No.	Course Code	Course Title	Hours per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	110801	Project	0	0	16	8	280	120
2.	110802	Seminar	-	-	4	2	30	20
					TOTAL	10	450	

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	20	26	26	26	26	18	10	172
Marks	750	750	750	800	750	850	450	450	5550

Program Elective Courses

S. N.	Code	Subject	Remarks
1.	110606	Electrical Machines Design	Elective-I
2.	110607	Electrical Drives	Elective-I
3	110608	Process Control System	Elective-I
4.	110609	Electrical Materials	Elective-I
5.	110610	Electrical Safety	Elective-I
6.	110702	Power System Analysis and Stability	Elective-II
7.	110703	Power System Operation and Control	Elective-II
8.	110704	Electric Vehicle	Elective-II
9.	110705	Industrial Electrical System	Elective-II
10.	110706	HVDC Transmission System	Elective-II
11.	110707	Power Plant Engineering	Elective-III
12.	110708	Wind and Solar Energy System	Elective-III
13.	110709	Power System Protection&Switchgear	Elective-III
14.	110710	Smart Grid Technology	Elective-III
15.	110711	Electrical Energy Conservation and Auditing	Elective-III

Open Elective Courses

S. N.	Code	Subject	Remarks
1.	110507	Object Oriented Programming	Elective-I
2.	110508	Operating System	Elective-I
3.	110509	Computer Architecture	Elective-I
4.	110510	Sales and Marketing	Elective-I
5.	110611	Embedded System	Elective-II
6.	110612	Introduction to Python Programming	Elective-II
7.	110613	Internet of Things	Elective-II
8.	110614	Entrepreneurship and Venture Development	Elective-II

9.	110712	AI and Machine Learning	Elective-III
10.	110713	Industrial Automation and Control	Elective-III
11.	110714	Biomedical and Instrumentation	Elective-III
12.	110715	Computer Network	Elective-IV
13.	110716	Sensors and Transducers	Elective-IV
14.	110717	Cyber Security	Elective-IV

SEMESTER – I

Course Code-100110 Engineering Physics 3 0 0 3

Unit- 1.0:

1. Frame of Reference: 2 hrs

Non-Inertial frame of reference, rotating coordinate system, centripetal and Coriolis acceleration and its application in weather system.

2. Oscillations: 3 hrs

Harmonic Oscillator, Damped Harmonic motion – overdamped, critically Damped and lightly damped oscillators, Force Oscillators and Resonance.

Unit- 2.0:

1. Optics: 4 hrs

Huygens' s Principle, Superposition of Waves and interference of Light by wave front-splitting and amplitude-splitting; Young' s double slit experiment, Michelson interferometer, Fraunhofer diffraction from single slit and circular aperture, Diffraction Grating and their resolving power

2. LASER: 4 hrs

Einstein' s theory of matter-radiations interaction, Einstein' s Coefficients (A and B), Amplification by population inversion, Different types of lasers – Gas Laser, Helium-Neon Laser, Solid State Laser (Ruby, Neodymium), Semiconductor Laser.

Unit- 3.0:

1. Quantum Mechanics: 5 hrs

Compton Effect, Photoelectric Effect, Wave Particle duality, de Broglie' s hypothesis, Heisenberg' s Uncertainty Principle, Wave function and wave packets, phase and group velocities, Schrodinger' s Wave Equation, Normalization, Expectation values, Eigenvalues and Eigenfunction.

2. Applications in One dimensions: 2 hrs

Application of Schrodinger Wave Equation for particle in one dimensional box – its wavefunction and eigenvalue of energy and momentum.

Unit- 4.0:

1. Vector Calculus: 2 hrs

Gradient, Divergence and Curl, Line, Surface and Volume integrals, Gauss' s Divergence

theorem and Stokes' theorem in Cartesian Coordinate.

2. Electrostatics: **4 hrs**

Gauss' s Law and its applications, Divergence and Curl of Electrostatic fields, Electrostatic Potential, Boundary Conditions, Poisson' s and Laplace' s equations, Dielectrics, Polarization, Bound Charges, Electric displacement, Boundary Conditions in dielectrics.

Unit- 5.0:

1. Magnetostatics: **4 hrs**

Lorentz force, Biot-Savart and Ampere' s circuital laws and their applications, Divergence and Curl of Magneto static fields, Magnetic vector potential, Force and torque on a magnetic dipole, Magnetic Materials, Magnetization, Bound currents, Boundary conditions.

2. Electrodynamics and Electromagnetic Waves: **4 hrs**

Ohm' s law, Motional EMF, Faraday' s Law, Lenz' s law, Self and mutual inductance, Energy stored in magnetic field, Maxwell' s equations in vacuum and nonconducting medium, Continuity Equation, Poynting Theorem, Wave Equations: plain electromagnetic wave in vacuum and their transverse nature and Polarization.

Unit- 6.0:

1. Introduction to Solids and Semi-Conductors: **3 hrs**

Free electron theory of metal, fermi level, Bloch' s theorem for particle in a periodic Potential, Kroning-Penney model and origin of energy band.

2. Electronic Materials: **3 hrs**

Metals, semiconductors and insulators, intrinsic and extrinsic semiconductors, Carrier transport, diffusion and drift, P-N junction.

Text/ Reference:-

1. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, R. Eisberg R. Resnick, Wiley India Pvt. Ltd ISBN 978-81-265-0818-1
2. Theory of Vibration with Application, W.T. Thomson M. D. Dahleh, Pearson India ISBN 978-81-317-0482-0
3. Introduction to Electrodynamics, D.J. Griffiths, Pearson India, ISBN 978-93-325-5044-5
4. Electromagnetism, I.S. Grant, W. R. Phillips, Wiley India Pvt. Ltd ISBN 978-04-719-2712-9
5. The Feynman Lectures on Physics, R.P. Feynman R. B. Leighton, Pearson India ISBN 978-00-710-7458-2
6. Optics, Ajay Ghatak ,McGraw Hill ISBN 978-93-901-1359-0
7. Physics of Vibration and Waves, H. J. Pain, Wiley India Pvt. Ltd, ISBN 978-04-700-1296-3
8. Concept of Modern Physics, Arthur Beiser, McGraw Hill ISBN 978-93-513-4185-7
9. Introduction to Solid State Physics, C. Kittle , Wiley India Pvt. Ltd, ISBN 978-81-265-7843-6

Course Code-100102 **Engineering Mathematics– I** **3 1 0 4**

Unit- 1.0: Linear Algebra-I **7 hrs**

Elementary Row operations, Gauss -Jordan Method for finding the inverse of Matrix, Complex Matrix : Hermitian , Skew Hermitian and Unitary Matrix, Vector space, Sub Spaces, Linear dependence and Independences of Vectors, Linear Span, Basis, Dimension, Extension of basis of subspace, The rank of a matrix, Row and column space, Solvability of system of linear equations.

Unit- 2.0: Linear Algebra-II **7 hrs**

Linear Transformations, Kernel and Range of linear transformation, Matrix Representation of a linear transformation, Rank-Nullity Theorem, Eigen Value and Eigen Vectors, Properties of Eigen vectors, Eigen Bases, Orthogonal Transformation, Similarity Transformation, Matrix Diagonalization, Cayley-

Hamilton Theorem.

Unit- 3.0: Calculus for single variable **7 hrs**

Inderminate form, L' Hospital Rule, Rolle' s Theorem, Mean Value Theorem, Expansion of function (single variable), Taylor and Maclaurin Series, Riemann Integration, Riemann Sum, Improper Integrals, Beta and Gamma function and their properties.

Unit- 4.0 : Multivariable Calculus (Differentiation) **7 hrs**

Function with two or more variable, Limit, continuity and Partial differentiation, Total Differentiation Taylor' s series and Maclaurin' s series for function with two variable, Jacobian, Maxima and Minima, Method of Lagrange' s multiplier.

Unit-5.0: Multivariable Calculus (Integration) **7 hrs**

Double Integral, change of order of integration, Triple integral, Change of Variable in a Double and Triple Integrals, Change to polar coordinate, Change to cylindrical coordinate, Change to spherical polar coordinate, Application to area and volume using double and triple integral

Unit- 6.0: Vector Calculus **7 hrs**

Scalar and vector fields, Gradient, Directional derivative, Divergence, Curl and their properties, Line integral, Green' s theorem in plane (without proof), Surface integral, Stoke' s theorem (without proof), Volume Integral, Gauss-Divergence' theorem (without proof).

Text/ Reference:-

1. AICTE' s Prescribed Textbook: Mathematics-I (Calculus&Linear Algebra), ReenaGarg, Khanna Book Publishing Co. ISBN-10 9391505171
2. Advanced Engineering Mathematics, Chandrika Prasad& Reena Garg, Khanna Book Publishing Co., 2021. ISBN 10: 9386173522 / ISBN 13: 9789386173522.
3. Higher Engineering Mathematics, B.V. Ramana, Tata McGraw Hill New Delhi, 11th Reprint, 2010,ISBN-10 007063419X ISBN-13978- 0070634190.
4. Advanced Engineering Mathematics, SrkIyengarRk Jain,Narosa,5thEdition,ISBN-10 8184875606I SBN-13978-8184875607
5. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley&Sons, 2006.

Course Code-100111 **Programming for Problem Solving** **3 0 0 3**

Unit- 1.0: Introduction to Programming **6 hrs**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit- 2.0: Operators, Conditional Branching and Loops **8 hrs**

Arithmetic expressions/arithmetic operators, relational operators, logical operators, bitwise operators and precedence. Writing and evaluation of conditionals and consequent branching, iteration and loops.

Unit- 3.0: Arrays and String **6 hrs**

Array declaration&initialization, bound checking arrays (1-d, 2-d), character arrays and strings.

Unit- 4.0: Function, Recursion and Pointers **9 hrs**

Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Idea of pointers, Defining pointers, Use of Pointers in self- referential structures, idea of call by reference.

Unit- 5.0: User defined Data Types and File handling **8 hrs**

Structure- defining, declaring, initializing; accessing structure members, processing of structure, array of structures, structures within structure, structure and function, type definition; Union— definition, declaration, accessing union members, initializing union. Introduction, file declaration, opening and closing a file, working with text and binary files, I/O operations on file, error handling, random access to files

Unit- 6.0: Basic Algorithms **5 hrs**

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Text/ Reference:-

1. Programming in ANSI C 4th Ed, E Balagurusamy, McGraw Hill Education India Private Limited, ISBN-978-9339219666, 7th Edition
2. The C Programming Language 2e,W. Kernighan / Dennis Ritchie, Pearson Education India, 978-9332549449, 2nd Edition
3. Computer Fundamentals and Programming in C, ReemaThareja, Oxford University Press, ISBN- 978-9354977893, 3rd Edition

Course Code-100106 **Basic Electrical Engineering** **3 0 0 3**

Unit- 1.0: DC Circuit Analysis and Network Theorems **8 hrs**

DC Circuit Analysis and Network Theorems: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R, L and C as linear elements; Source Transformation; Kirchhoff' s Law, loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin' s Theorem, Norton' s Theorem, and Maximum Power Transfer Theorem. (Simple Numerical Problems)

Unit- 2.0: Magnetic Circuit **5 hrs**

Magnetic Circuit: Magnetic circuit concepts, analogy between Electric & Magnetic circuits, Magnetic circuits with DC and AC excitation, Magnetic leakage. B-H curve, Hysteresis and Eddy Current losses, Magnetic circuit calculations.

Unit- 3.0: Steady State Analysis of Single-Phase AC Circuits **8 hrs**

Steady State Analysis of Single-Phase AC Circuits: Sinusoidal, Square and Triangular waveforms– average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active&Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits. (Simple Numerical Problems)

Unit- 4.0: Three Phase AC Circuits **5 hrs**

Three Phase AC Circuits: Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage/ current relations, three phase power and its measurement. (Simple Numerical Problems)

Unit- 5.0: Introduction to DC Machines **10 hrs**

Introduction to DC Machines: Principal, Operation, Construction, and types of DC machines, EMF equation of generator and torque equation of motor.

Single Phase Transformer: Principle of Operation, Construction, EMF equation, losses in transformer, efficiency.

Three Phase Induction Motor: Principal, Operation, and Construction (Simple Numerical Problems)

Unit- 6.0: Soldering **6 hrs**

Soldering-Soldering and desoldering techniques, breadboard wiring, general-purpose PCB soldering/wiring. Wiring-Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board.

Text/ Reference:-

1. Basic Electrical Engineering, D.P. Kothari et al, McGraw-Hill Education 4th Edition,2019
2. Electrical and Electronic Technology Edward Hughes, 12th edition, 2016
3. Principles Electrical Engineering and Electronics, V.K Mehata, Rohit Mehta, S Chand and Company 2nd edition, 2015
4. Basic Electrical Engineering, J. B. Gupta, Katson Publication
5. A textbook of Electrical Technology B. L. Thereja, A. K. Thereja Vol. 1, 2, and 3 S Chand Publication

Course Code-100112 **Workshop Practices** **2 0 0 2**

Unit-1.0: Sheet Metal Working **6 hrs**

Sheet material: GI sheets, aluminum, tin plate, copper, brass etc; Tools: steel rule, vernier callipers, micrometer, sheet metal gauge, scriber, divider, punches, chisels, hammers, snips, pliers, stakes etc.; operations: scribing, bending, shearing, punching etc; Product development: hexagonal box with cap, funnel etc.

Unit-2.0: Joining **6 hrs**

Classifications of joining processes; Brazing, Soldering, and Mechanical Joints, Arc welding, Gas welding etc.

Unit-3.0: Pattern Making and Foundry Practice **6 hrs**

Pattern material: wood, cast iron, brass, aluminum, waxes etc.; Types of patterns: split, single piece, match plate etc; Tools: cope, drag, core, core prints, shovel, riddle, rammer, trowel, slick, lifter, sprue pin, bellow, mallet, vent rod, furnace etc. Moulding sands: green sand, dry sand, loam sand, facing sand etc., Sand casting: Sand preparation, mould making, melting, pouring, and cleaning

Unit-4.0: Fitting Shop **10 hrs**

Introduction to Fitting; Fitting Tools: Files and their classification, Holding Tools, Cutting Tools, Measuring and Marking Tools, Thread Making Tools, Various Fitting Power Tools; Methods Of Filing: Cross Filling and Draw Filing, Other associated operations Marking. Sawing and Chipping; Safety and Precautions in Fitting Shop.

Unit-5.0: Carpentry Shop **7 hrs**

Introduction to Carpentry Shop; Types of Wood; Seasoning of Wood: Types of Seasoning Methods; Defects in wood; Structure of Wood; Carpentry Tools; Measuring Tools, Marking Tools, Cutting Tools, Planning Tools, Drilling and Boring Tools, Holding Tools, Striking Tools, Auxiliary tools and materials

used in Carpentry; Wood working Processes; Carpentry joints; wood Working Machines: Wood Working Lathe, Circular Saw, Thickness Planer, Band saw, Safety and precautions in Carpentry Shop.

Unit-6.0: Smithy Shop **5 hrs**

Introduction to Smithy Sho; Forging Tools and Equipment; Forging Operations: Drawing, Upsetting, Swaging, Punching, Drifting, Fullering, Bending; Hot Working Processes: Rolling, Drop Forging, Press Forging, Hot Extrusion, Hot Drawing, Cold Working Process, Safety and Precautions in Smithy Shop.

Text/ Reference:-

1. Hajra Choudhury S.K., Hajra Choudhury A.K. And Nirjhar Roy S.K., "Elements of Workshop Technology" , Vol. I 2008 And Vol. Ii 2010, Media Promoters And Publishers Private Limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering And Technology" , 4th Edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan And A. Suresh Babu," Manufacturing Technology – I " Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials Of Manufacture" , 4th Edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology" , Vol. I And Vol. Ii, Tata Mc graw hill House, 2017.

Course Code-100110P Engineering Physics Lab 0 0 2 1

Perform any 10 Experiments

1. Determination of the capacitance and permittivity of the given material.
2. Determination of e/m of electron.
3. Determination of Planck' s constant and Photoelectric Work Function using Photoelectric cell.
4. Verification of inverse square law using photocell.
5. Determination of Wavelength of (He-Ne) LASER using Diffraction Grating Method.
6. Calculation of Energy Band Gap of a semiconductor.
7. Determination of Dielectric constant using resonance method.
8. Determination of Wavelength of Sodium light by measuring the diameter of the Newton' s Ring.
9. Determination of curvature of convex surface of a lens by Newton' s ring.
10. Verification of existence of Bohr' s Energy level with Frank-Hertz apparatus.

11. Determination of the Earth' s horizontal magnetic field intensity and magnetic Moment of a magnet by employing magnetometer.
12. Verification of Faraday' s Law and Lenz' s Law of Electromagnetic Induction.

Course Code-100111P Programming for Problem Solving Lab 0 0 2 1

Perform any 10 Experiments

1. Problem solving using computers:

Lab1: Familiarization with programming environment

2. Variable types and type conversions:

   Lab 2: Simple computational problems using arithmetic expressions

3. Branching and logical expressions:

   Lab 3: Problems involving if-then-else structures

4. Loops, while and for loops:

   Lab 4: Iterative problems e.g., sum of series

5. 1D Arrays: searching, sorting:

   Lab 5: 1D Array manipulation

6. 2D arrays and Strings

   Lab 6: Matrix problems, String operations

7. Functions, call by value:

   Lab 7: Simple functions

8. Numerical methods (Root finding, numerical differentiation, numerical integration):

   Lab 8 and 9: Programming for solving Numerical methods problems

9. Recursion, structure of recursive calls

   Lab 10: Recursive functions

10. Pointers, structures and dynamic memory allocation

    Lab 11: Pointers and structures

11. File handling:

    Lab 12: File operations

Course Code-100106P **Basic Electrical Engineering Lab** **0 0 2 1**

Perform all Experiments

1. Verification of Kirchhoff' s laws.
2. Verification of Superposition Theorem.
3. Verification of Thevenin' s Theorem.
4. Verification of Norton' s Theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Measurement of power in 3 – Ø circuit by Two Watt meter method and determination of its power factor.
7. Star to Delta and Delta to Star conversion of the three circuit.
8. Determination of Efficiency by load test of a 1 – Ø Transformer.
9. To study the typical BHK house wiring
10. Study of safety precautions while working on electrical installations and necessity of earthing

Course Code-100112P **Workshop Practices Lab** **0 0 2 1**

Perform all Experiments

List of Practical:

1. Learn and apply of different fitting tools – like work holding, marking, measuring, cutting, finishing and miscellaneous. Student will also prepare the report with sketch, specifications and applications of fitting tools demonstrated.
2. Prepare one simple and another male-female type fitting jobs as per given drawings- 2 jobs
3. Learn and apply of different tin smithy tools. Student will also prepare the report with sketch, specifications and applications of tin smithy tools demonstrated.
4. Learn and apply of welding equipments and making minimum one model.
5. Learn and apply of foundry tools and making minimum one model.
6. Learn and apply of carpentry tools and making minimum one model.
7. Learn and apply of Sheet Metal tools and making minimum one model.
8. Learn and apply of Lathe Tools&operations for making a job.
9. Learn and apply the application of measuring tools.
10. Learn and apply any casting process for making a model

Course Code-100115P **Swatch Bharat Mission** **0 0 2 1**

Objectives:

1. Understanding the importance of cleanliness and sanitation: The course could aim to create awareness about the significance of cleanliness and sanitation in maintaining personal health, environmental sustainability, and community well-being. It could cover topics such as waste management, sanitation practices, and the impact of poor sanitation on public health.
2. Developing skills for effective waste management: The course could provide training on various waste management techniques, such as waste segregation, composting, recycling,and proper disposal of hazardous waste. It could also emphasize the importance of reducing waste generation and promoting sustainable waste management practices.
3. Promoting behavioural change towards cleanliness: The course could focus on influencing positivebehavioural change among individuals and communities towards cleanliness. It could include modules on promoting good hygiene practices, creating awareness about the harmful effects of littering and open defecation, and encouraging responsible waste disposal habits.
4. Creating awareness about Swachh Bharat Mission initiatives: The course could provide information about the Swachh Bharat Mission initiatives and campaigns launched by the Government of India to promote cleanliness and sanitation, such as Swachh Survekshan, Swachh Bharat Abhiyan, and Clean India Campaign. It could also discuss the progress made, challenges faced, and future prospects of the Swachh Bharat Mission.
5. Engaging in community participation and advocacy: The course could emphasize the importance

of community participation in the Swachh Bharat Mission and provide tools and strategies for engaging with local communities to promote cleanliness and sanitation. It could also encourage advocacy for policy changes and innovations to address sanitation-related issues at the community, regional, and national levels.

6. Increased awareness and knowledge about cleanliness and sanitation: Participants of the course may gain a deeper understanding of the importance of cleanliness and sanitation, including the impact on personal health, environmental sustainability, and community well- being. They may learn about various waste management techniques, hygiene practices, and the initiatives of the Swachh Bharat Mission.

7. Enhanced skills for effective waste management: Participants may acquire practical skills related to waste management, such as waste segregation, composting, recycling, and proper disposal of hazardous waste. They may also develop skills in reducing waste generation and promoting sustainable waste management practices in their communities or workplaces.

8. Positive behavioral change towards cleanliness: The course may influence participants to adopt positive behavioral changes towards cleanliness, such as avoiding littering, practicing good hygiene habits, and promoting responsible waste disposal. Participants may develop a sense of responsibility towards maintaining cleanliness in their surroundings and actively contribute towards creating a cleaner environment.

9. Increased community participation and advocacy: Participants may become actively engaged in community participation and advocacy efforts related to cleanliness and sanitation. They may collaborate with local communities, government bodies, and non-governmental organizations (NGOs) to raise awareness, implement cleanliness initiatives, and advocate for policy changes or innovations to address sanitation-related issues.

10. Contribution towards Swachh Bharat Mission objectives: Participants may contribute towards the objectives of the Swachh Bharat Mission, such as promoting cleanliness, ensuring proper waste management, and eliminating open defecation. They may actively participate in Swachh Bharat Mission campaigns, initiatives, and activities, and make a positive impact on their communities and society at large.

11. List of Reports:

12. Any topics related to Swatch Bharat Mission

SEMESTER-II

Course Code-100215 Engineering Chemistry 3 0 0 3

Unit-1.0: Atomic and Molecular Structure 8 hrs

Electromagnetic radiations, Dual nature of electron and Heisenberg uncertainty Principle, Photoelectric effect, Planck's theory. Principles for the combination of atomic orbitals to form a

molecular diagram of molecular orbitals. Bent's rule, VSEPR theory (typical example) co-ordination numbers and geometries. Isomerism in transition metal compounds. Metal Carbonyls; Synthesis and Structure.

Unit-2.0: Spectroscopy **6 hrs**

Principle of rotational and vibrational spectroscopy, selection rule for application in diatomic molecules, elementary idea of electronic spectroscopy, UV-VIS spectroscopy with related to rules and its applications. Basic Principle of nuclear Magnetic resonance spectroscopy with applications.

Unit-3.0: Electrochemistry and Fuels **6 hrs**

Nernst equation, EMF and electrochemical cell, the introduction of corrosion, corrosion mechanism, types of corrosion, water line corrosion, stress corrosion, pitting corrosion, Lead acid storage cell, leclanche cell. Calorific value of fuels, proximate and ultimate analysis of coals, fuel cells, Bio fuels.

Unit-4.0: Water Chemistry **8 hrs**

Hardness of water, estimation of water hardness by EDTA and Alkalinity method. Removal of the hardness of water- soda lime process, zeolite process, Ion exchange process, Boiler problem, sludge, and scale formation, priming and foaming, Boiler corrosion, and Caustic embrittlement.

Unit-5.0: Polymer and Plastics **8 hrs**

Polymerization techniques (free radical, ionic, and co-ordination mechanism) Preparation properties, and technical application of phenol-formaldehyde resins, elastomers, synthetic rubbers (Buna-S, Buna-N, neoprene). Inorganic polymers, Silicones, adhesives, epoxy resins. the structural difference between thermoplastic and thermosetting Plastics, the Importance of commercially important thermoplastics and thermosets; Poly ethylene, Polyvinyl chloride, Polystyrene.

Unit-6.0: Organic Reactions and Synthesis of a Drug Molecule **6 hrs**

Introduction to intermediate and reaction involving Substitution, addition, elimination, oxidation-reduction. Diels Elder cyclization and epoxide ring opening reactions, synthesis of commonly used drug molecules like aspirin.

Text/ Reference:-

1. University Chemistry, B.H. Mahan, Pearson
2. Chemistry, principles and application, M.J. Sienko and R.A. Plane, McGraw Hill International
3. Fundamentals of molecular Spectroscopy, C.N. Banwell , McGraw Hill International
4. Engineering Chemistry (NPTEL Web- Book), B.L. Tembe, Kamaluddin and M.S. Krishnan, NPTEL
5. Physical Chemistry, P.W. Atkins, Oxford University Press
6. A text book of engineering chemistry, S. Chawala, Dhanpat Rai Publication
7. General Chemistry Part 1, R. Sarkar, New Central Book agency

Course Code-100202 Engineering Mathematics– II 3 1 0 4

Unit- 1.0: Complex Analysis – I 6 hrs

Functions of complex variable, limit, Continuity, Differentiability, Analytic function, Cauchy-Riemann Equations in Cartesian and polar form, harmonic function and harmonic conjugate.

Unit- 2.0: Complex Analysis – II 8 hrs

Line Integral, contour integrals, Cauchy theorem, Cauchy' s Integral formula(without proof), Taylors series, zero of analytic functions, singularities, Laurent' s series, residue, Cauchy residue theorem(without Proof) and its applications.

Unit- 3.0: Ordinary Differential Equations 8 hrs

Linear differential equations of nth Order with constant coefficients, solution of Homogeneous and Non-Homogeneous Equations, Equations with variable coefficients, Cauchy- Euler Equations, Method of Variation of Parameters.

Unit- 4.0: Sequence and Series 6 hrs

Introduction of Sequence and Series, Nature of series Tests of convergence of Series: Comparison test, D' Alembert ratio test, Cauchy' s Root test, Raabe' s test, Logarithmic test, Cauchy' s condensation test.

Unit- 5.0: Laplace Transform 8 hrs

Laplace Transform, Existence theorem, properties of Laplace Transform, Laplace Transform of Periodic functions, Inverse Laplace Transform, convolution theorem. Application of Laplace Transform to solve Ordinary differential equations.

Unit- 6.0: Fourier Series 6 hrs

Fourier Series, Fourier Series for odd and even functions, Half range sine and cosine series, Parseval' s theorem.

Text/ Reference:-

1. Advanced Engineering Mathematics, Kreyszig Erwin, John Wiley and Sons,10th Edition,2020 ISBN:978-0470-45836-5
2. Advanced Engineering Mathematics, Dass H.K., S Chand and Company pvt.Ltd.,22nd Edition,2018 ISBN:978-93-5283-718-2
3. Higher Engineering Mathematics, Grewal B.S., Khanna Publishers,44th Edition,2023 ISBN:9788174091154
4. Complex Variables (Theory and Applications), Kasana H.S., PHI,2nd Edition.2015 ISBN:978-81-203-2641-5
5. A Text Book of Engineering Mathematics, Bali N.P., Goyal Manish Laxmi Publications,9th Edition,2014

6. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill New Delhi, 11th Reprint, 2010, ISBN-10 007063419X ISBN-13 978- 0070634190
7. Differential Equations, Ross S.L., Wiley Publications,3rd edition,2016 ISBN:978-81-265—1537-0
8. Advanced Differential Equations, Raisinghania M.D., S.Chand and Company PVT.LTD.,18th Edition,2015 ISBN:978-81-219-0893-1
9. Schaum' s Outlines Complex Variables, Spiegel Murray R, Lipschutz Seymour, Schiller J John and Spellman Dennis, MC Graw Hill Education Private Ltd.2nd Edition,2010 ISBN:978-0-07-008538-1

Course Code-100216 Communicative English 3 0 0 3

Unit-1.0: Vocabulary Building 7 hrs

Nature of Word Formation; Root Word and Morpheme; Prefix and Suffix; Foreign Expressions in English; Synonym and Antonym; Homophone and Homograph; Abbreviation and Acronym.

Unit-2.0: Basic Writing Skills 7 hrs

Parts of Speech: Types of Words; Structures of Sentence; Kind of Sentence; Phrase and Clause; Punctuation Marks; Capitalization; Tenses: Present, Past and Future; Voices: Active and Passive; Formation of Questions using Primary Auxiliaries, Modals and Wh-Words.

Unit-3.0: Common Errors in English 7 hrs

Articles; Prepositions; Modifiers; Subject-Verb Agreement; Noun-Pronoun agreement; Redundancies; Cliches; Spelling Error.

Unit-4.0: Principles of Appropriate Writing 7 hrs

Defining: Describing, Classifying and Exemplifying; Introduction, Body, and Conclusion; References, Quotations and Illustrations; Organizing the Paragraphs in a Document; 7Cs of the Professional Writing: Clear, Concise, Concrete, Correct, Coherent, Complete and Courteous.

Unit-5.0: Practices of Formal Writing 7 hrs

Formal Letter: Cover-Letter and Application; Resume Writing; Report Writing; Minutes of Meeting; Memorandum; Notice; Essay Writing: Personal and Impersonal; Email Writing Etiquettes; Article Writing; Writing for Current Social Media.

Unit-6.0: Comprehension of Written English 7 hrs

Of Studies (Essay) by Sir Francis Bacon; *The Sun Rising* (Poem) by John Donne; *The Last Leaf* (Story) by O Henry; Unseen/Untaught Passage.

Text/ Reference:-

1. English language and communication skills for engineers, Sanjay Kumar, Pushplata, Oxford university Press
2. Communicative English for Technical student, Dr. Bijay Bhadur Singh and Dr. Kalpana Sinha, Foundation publishing House (FPM)
3. Communication Skill (As per VRV syllabus 2018),Sanjay Kumar and Pushplata, Oxford University Press
4. A course in Listening & Speaking, V. Sasi Kumar ,P. Kiranmai Dutt and Geetha Rajeevan, Foundation Books

Course Code-100220P **Sports/Yoga/NCC/NSS** **0 0 2 1**

Course Objectives:

(a) Encouraging creativity and innovation: The course could aim to foster a culture of creativity and innovation among engineering students. It could provide opportunities for students to generate and develop new ideas, think critically, and come up with innovative solutions to real-world problems. This objective could be achieved through brainstorming sessions, design thinking exercises, and hands-on projects.

(b) Enhancing problem-solving skills: The course could focus on enhancing the problem-solving skills of engineering students. It could provide training on various problem-solving techniques, such as root cause analysis, critical thinking, and decision-making. Students may learn how to identify and analyse complex problems, develop feasible solutions, and implement them effectively.

(c) Developing project management skills: The course could aim to develop project management skills among engineering students. It could cover topics such as project planning, scheduling, budgeting, and risk management. Students may learn how to manage resources, communicate effectively, and work collaboratively in a project-based environment.

(d) Promoting interdisciplinary collaboration: The course could encourage interdisciplinary

collaboration among engineering students. It could provide opportunities for students from different engineering disciplines to work together on innovative projects. This could foster cross-disciplinary learning, encourage diverse perspectives, and promote teamwork and collaboration skills.

(e) Facilitating practical application of engineering concepts: The course could focus on the practical application of engineering concepts and principles. It could provide students with opportunities to apply their theoretical knowledge to real-world projects, prototypes, or simulations. Students may learn how to translate engineering theories into practical solutions and develop hands-on experience in implementing innovative projects.

Course Outcome:

1. Developed innovative projects: Students may have successfully developed innovative projects that demonstrate their creativity, problem-solving skills, and technical competence. These projects could be prototypes, models, simulations, or practical solutions to real-world problems, showcasing their ability to apply engineering concepts in a creative and innovative manner.
2. Improved critical thinking and problem-solving skills: Students may have honed their critical thinking and problem-solving skills through various course activities, such as brainstorming, design thinking, and project development. They may have learned to analyse complex problems, identify viable solutions, and make informed decisions based on technical, economic, and social considerations.
3. Enhanced project management and teamwork skills: Students may have gained practical experience in managing projects, including planning, scheduling, budgeting, and risk management. They may have learned how to work effectively in a team, collaborate with diverse team members, and communicate project progress and results professionally.
4. Increased interdisciplinary knowledge and collaboration: Students may have gained exposure to interdisciplinary concepts and collaborated with peers from different engineering disciplines. They may have learned to appreciate diverse perspectives, leverage interdisciplinary knowledge, and work collaboratively to develop innovative solutions that integrate multiple domains of engineering.
5. Cultivated a mindset of innovation and entrepreneurship: Students may have developed a mindset of innovation and entrepreneurship, recognizing the importance of creativity, adaptability, and continuous improvement in engineering practice. They may have learned to identify opportunities, think critically, and take risks to develop and implement innovative projects with commercial or societal potential.

List of Reports; Any topics related to innovative project.

Course Code-100209 **Basic Electronics** **3 0 0 3**

Unit-1.0: Semiconductor diode **9 hrs**

Intrinsic and extrinsic types, energy band in intrinsic and extrinsic Semiconductor, equilibrium carrier concentration Direct and indirect band-gap semiconductor. Ideal diode Construction, p-n junction

under open circuit, drift, and diffusion current, built in potential, forward bias, and reverse bias condition. Effect of temperature, static and dynamic resistance, breakdown mechanism in diode, Junction capacitance. Zener diode Working, VI characteristics Light emitting Diode, Photodiode, Solar cell.

Unit- 2.0: Diode Applications **7 hrs**

Half wave rectifiers, Full wave rectifiers&Rectifier with filters, Zener diode application as voltage regulator, Clipping and Clamping circuits, Voltage doubler (includes numerical on rectifier, filter, and Zener regulator)

Unit- 3.0: Bipolar Junction Transistor **8 hrs**

BJT introduction: Construction, Symbol, and types (PNP and NPN), working of BJT, BJT configuration and characteristics, Load line analysis, Operating point, Need for Biasing, different Biasing circuits, Bias stability. BJT as a switch&Amplifier, low frequency small signal model of BJT, CE amplifier with and without feedback

Unit- 4.0: Field Effect Transistor **6 hrs**

General characteristics of FET; Comparison between FET&BJT; JFET: Construction, Principle of Operation, Shockley equation. Output and transfer characteristics; Depletion&Enhancement Type MOSFET: Construction, Principle of operation. Output and transfer characteristics;

Unit- 5.0: Operational Amplifier **6 hrs**

Block diagram of an Operational amplifier, schematic symbol, characteristics of an ideal and practical operational amplifier, concept of virtual ground, Inverting and non-inverting amplifier, voltage follower, adder, subtractor, integrator and differentiator.

Unit- 6.0: Fundamental of Digital Electronics **6 hrs**

Introduction to number system: octal, Hexadecimal, Binary numbers, Binary addition using 1' s and 2' s complement method. logic gates, Universal gates, Boolean Algebra, De Morgan' s theorems, Simplification, and realization of Boolean expression using basic gates and NAND gates.

Text/ Reference:-

1. Electronic Device & Circuit theory Boylestad and Nashelsky Pearson
2. Electronic Principles Albert Malvino & Davis J. Bates TMH
3. Digital logic and computer design M. Morris Mano PHI
4. Electronic Devices and Circuit David A Bell Oxford
5. Microelectronic Circuit: Theory and Application Sedra and Smith Oxford

Course Code-100217 **Engineering Graphics and Design** **1 0 0 1**

Unit- 1.0: Introduction to Engineering Drawing **7 hrs**

Principles of Engineering Graphics and Their Significance, Usage of Drawing Instruments, Lettering, Conic Sections including the Rectangular Hyperbola (General Method Only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales Plain, Diagonal and Vernier Scales

Unit- 2.0: Orthographic Projections **7 hrs**

Principles of Orthographic Projections - Conventions -Projections of Points and Lines Inclined to Both Planes; Projections of Planes Inclined Planes Auxiliary Planes.

Unit- 3.0: Projections of Regular Solids **7 hrs**

Types of Solids, Projects of Solids (Prism, pyramids, cone, and cylinder): Inclined to Both the Planes- Auxiliary Views; Draw Simple Annotation, Dimensioning and Scale.

Unit- 4.0: Sections and Sectional Views of Right Angular Solids **7 hrs**

Section of Solids (Prism, Cylinder, Pyramid, Cone), Auxiliary Views; Development of Surfaces Of Right Regular Solids- Prism, Pyramid, Cylinder And Cone; Draw The Sectional Orthographic Views of Geometrical Solids, Objects From Industry And Dwellings (Foundation To Slab Only).

Unit- 5.0: Isometric Projections **7 hrs**

Isometric views, Compound Solids; Principles of Isometric Projection Isometric Scale, Conventions; Isometric views of Lines, Planes, Simple and Conversion of Isometric views to Orthographic views and vice-Versa, Conventions.

Unit- 6.0: Overview of Computer Graphics **7 hrs**

Listing the Computer Technologies that Impact on Graphical Communication, Demonstrating Knowledge of the Theory of CAD Software Such As: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify And Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog Boxes And Windows, Shortcut Menus (Button Bars), The Command Line (Where Applicable), The Status Bar, Different Methods of Zoom as Used in CAD, Select and Erase Objects.; Isometric Views of Lines, Planes, Simple And Compound Solids.

Text/ Reference:-

1. Engineering Drawing, N.D. Bhatt, Charotar Publishing House, 53rd Edition, ISBN: 978-9380358277
2. A Textbook of Engineering Drawing, R.K. Dhawan, S. Chand Publishing, Revised Edition, ISBN: 978-8121929571
3. Engineering Drawing and Graphics, K. Venugopal, V. Prabhu Raja, New Age International Publishers, 3rd Edition, ISBN: 978-8122430120
4. Engineering Graphics with AutoCAD, D.M. Kulkarni, A.P. Rastogi, A.K. Sarkar, PHI Learning Pvt. Ltd., 1st Edition, ISBN: 978-8120337834

Course Code-100215P **Engineering Chemistry Lab** **0 0 2 1**

Perform any 10 Experiments

1. To estimate hardness of water by alkalinity method
2. To estimate hardness of water by EDTA method
3. To remove hardness of water by ion exchange method
4. Determination of pH of a given acid solution using a standard sodium hydroxide solution
5. Determination of surface tension and viscosity
6. Chemical analysis of salt (Acid radical and basic radical)
7. Adsorption of acetic acid by charcoal
8. Test of adulteration of fat butter, sugar, turmeric powder, chilli powder and pepper
9. Saponification/ acid value of an oil
10. Identification of organic substances and their functional groups
11. Potentiometric determination of redox potentials and emf
12. Synthesis of drug/ polymer like ASPRIN/ Urea- formaldehyde resin
13. Thin layer chromatography
14. Analysis of flue gas by orsat apparatus

Course Code-100216P **Communicative English Lab** **0 0 2 1**

Perform any 10 Experiments

Language Lab of English includes Listening Comprehension, Reading Comprehension, Speaking Skills: Phonetics, International Phonetic Alphabet Symbols (IPAS), Sounds: Vowels and Consonants, Pronunciation, Intonation, Stress and Rhythm, Just A Minute Technique (JAM), Communication: Verbal and Non-Verbal; Ethical Usage of Artificial Intelligence, Self-Introduction: Social, Academic and Professional; Interview: Online and Offline; Oral Presentation, Debate, Group Discussion, Group-Activities, and Brainstorming Vocabulary Activities.

1. Listening Comprehension and Speed (Software)
2. Reading Comprehension and Speed (Software)
3. Pronunciation: Learning and Test (Software)
4. Self-Introduction: Social, Academic and Professional
5. English Typing: Microsoft Word Document (MS Word), and Microsoft Power Point Presentation (PPT)
6. Oral Presentation
7. Interview: Online and Offline
8. Just A Minute Technique (JAM) and Extempore
9. Debate

10. Group Discussion
11. Activities: Role Play, Peer Activities, and Group Activities
12. Anchoring and Addressing: an Assembly, a Meeting, a Seminar, a Party

Course Code-100209P **Basic Electronics Lab** **0 0 2 1**

Perform any 10 Experiments

1. Study of Cathode Ray Oscilloscope (CRO) (a) Measurement of amplitude, time period and frequency of unknown continuous signals.
2. Identification of active and passive component.
3. Study the characteristics of P-N junction diode under (a) Forward bias, and (b) Reverse bias.
4. Study of clipping circuits and clamping circuits.

5. To recognize a half -wave rectifier and full-wave rectifier using sinusoidal voltage.
6. Study of Full wave rectifier using Capacitor filter.
7. To recognize voltage regulator using Zener diode.
8. Study of the input and output characterization of common base (CB) bipolar junction transistor.
9. Study the input and output characterization of common emitter (CE) bipolar junction transistor.
10. Study the output and transfer characteristics of JFET (Junction field effect transistor)
11. Study of operational amplifier as (i) Inverting (ii) Non-inverting amplifier.
12. Study of operational amplifier as (i) Integrator (ii) Differentiator.
13. Construction and verification of all other gate (AND, OR, NOT, XOR) using only a) NOR gate b) only NAND gate.

Course Code-100217P **Engineering Graphics and Design Lab** **0 0 4 2**

Perform any 10 Experiments

1. (Which includes dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil)
2. Construction of Plane, Diagonal&Vernier Scales.
3. Construction of Ellipses, Parabolas, and Hyperbolas using the general method.
4. Construction of cycloid, epicycloid, hypocycloid, and involute of a circle.
5. Projection of Points and Lines inclined to both planes.
6. Projections of Planes (e.g., rectangular, triangular) in inclined positions.
7. Projection of Solids (prisms, pyramids, cones, and cylinders)
8. Drawing of Sections of Prisms, Cylinders, Pyramids, and Cones.
9. Development of Surfaces for prisms, pyramids, cylinders, and cones.
10. Construction of Isometric views of lines, planes, and simple solids.
11. Introduction to CAD Software.
12. Use of CAD software to draw basic geometric shapes, apply dimensions, and modify objects.

Semester-III

Course Code-110301 Electrical Circuit Analysis 3 1 0 4

Unit-1.0: Introduction to Electrical Circuit Analysis 5 hrs

Circuit Elements, Linear and Non-Linear Devices, Active and Passive Devices, Unilateral and Bilateral Devices, Energy Sources (Voltage Source&Current Source), Source Transformation, Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Unit-2.0: Network Theorems 8 hrs

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Millman' s Theorem, Tellegen' s Theorem, Substitution Theorem.

Unit-3.0: Solution of First and Second Order Networks 8 hrs

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit-4.0: Electrical Circuit Analysis Using Laplace Transforms 8 hrs

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Series and parallel resonances

Unit-5.0: Two-Port Network 7 hrs

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters, and hybrid parameters, interconnections of two port networks

Unit-6.0: Network Graph and Applications 6 hrs

Network Graph and their applications in Network Analysis.

Text/Reference:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.

3. W. H. Hayt & J. E. Kemmerly, "Engineering Circuit Analysis", McGraw-Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw-Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999
6. Kuo, Franklin. Network analysis and synthesis. John Wiley&Sons, 2006

Course Code-110302 **Digital Electronics** **3 1 0 4**

Unit-1.0: Fundamentals of Digital Systems and logic families **6 hrs**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive OR operations, Boolean algebra, number systems-binary, signed binary, octal, hexadecimal number, binary arithmetic, one' s and two' s complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, , examples of IC gates, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit-2.0: Combinational Digital Circuits **8 hrs**

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don' t care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Sub tractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Quine-Mc cluskey method of function realization.

Unit-3.0: Sequential circuits and systems **8 hrs**

A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K, T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous)

counters, synchronous counters, counters design using flip flops, special counter ICs, asynchronous sequential counters, applications of counters.

Unit-4.0: A/D and D/A Converters **8 hrs**

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Unit-5.0: Semiconductor memories and Programmable logic devices **8 hrs**

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD.

Unit-6.0: **4 hrs**

Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/ Reference:-

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education,2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India,2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India,2016.

Course Code-110303 **Engineering Mathematics-III (PDE, Prob/stat)** **3 1 0 4**

Unit 1.0 **7 hrs**

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

Unit 2.0 **8 hrs**

Second-order linear equations and their classification, Initial and boundary conditions, D' Alembert' s solution of the wave equation; Duhamel' s principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables

Unit 3.0 **8 hrs**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev' s Inequality.

Unit 4.0 **5 hrs**

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Unit 5.0 - **7hrs**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis – Probability distributions: Binomial, Poisson and Normal – evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Unit 6.0- **7 hrs**

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances – Chi- square test for goodness of fit and independence of attributes.

Text/ Reference:-

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley&Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India,2002

Course Code-110304 Electromagnetic Field Theory 3 1 0 4

Unit-1.0: Review of Vector Calculus 6 hrs

Vector algebra: addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical, and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator del, gradient, divergence, and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Unit-2.0: Static Electric Field 6 hrs

Coulomb' s law, Electric field intensity, Electrical field due to point charges. Line, Surface, and Volume charge distributions. Gauss' law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy, and Energy density

Unit-3.0: Conductors, Dielectrics, and Capacitance 6 hrs

Current and current density, Ohm's Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line, Poisson' s equation, Laplace' s equation, Solution of Laplace and Poisson' s equation, Application of Laplace' s and Poisson' s equations.

Unit-4.0: Static Magnetic Fields & Time Varying Fields 12 hrs

Static Magnetic Field: Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current-carrying conductors

Time Varying Field: Faraday' s law for Electromagnetic induction, Displacement current, Point form of Maxwell' s equation, Integral form of Maxwell' s equations, Motional Electromotive forces. Boundary Conditions.

Unit-5.0: Magnetic Forces, Materials, and Inductance 6 hrs

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Unit-6.0: Electromagnetic Waves 6 hrs

Derivation of Wave Equation, Uniform Plane Waves, Maxwell' s equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem

Text/ Reference:-

1. W. Hayt,&J. A. Buck, Engineering Electromagnetics, 6th Edition, Tata McGraw-Hill, 2015
2. M. N. O. Sadiku, Principles of Electromagnetics, 6th edition, Oxford University Press, 2015
3. David K. Cheng (1989), Fields and Waves Electromagnetics, 2nd edition, Pearson Education
4. A. Pramanik, "Electromagnetism - Theory and applications" , PHI Learning Pvt. Ltd, New Delhi, 2009
5. E.G. Cullwick, "The Fundamentals of Electromagnetism" , Cambridge University Press, 1966

Course Code-110305 Signals and Systems 3 0 0 3

Unit- 1.0: Introduction to Signals and Systems 7 hrs

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit- 2.0: Behavior of continuous and discrete-time LTI systems 6 hrs

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State space representation of systems. State-Space analysis, Multi-input multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit- 3.0: Fourier series and Fourier Transform 8 hrs

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

Unit- 4.0: Laplace Transform 6 hrs

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior.

Unit- 5.0: Sampling and Reconstruction **8 hrs**

The Sampling theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Unit- 6.0: Z-Transform **7 hrs**

The Z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, region of convergence, Z-domain analysis**;** Unilateral Laplace transform, difference equations, system representations: direct, cascade, parallel forms

Text/ Reference:-

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum' s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

Course Code-110306 Universal Human Values 3 0 0 3

Unit- 1.0: Introduction to Value Education **5 hrs**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education Sharing about Oneself, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Exploring Human Consciousness, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations,

Unit- 2.0: Harmony in the Human Being **4 hrs**

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Unit- 3.0: Harmony in the Family and Society **5 hrs**

Harmony in the Family – the Basic Unit of Human Interaction, ‗ Trust ' – the Foundational Value in Relationship, ‗ Respect ' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Unit- 4.0: Harmony in the Nature/Existence 6 hrs

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

Unit- 5.0: Implications of the Holistic Understanding – a Look at Professional 5 hrs

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession .

Unit- 6.0: 3hrs

Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Text /Reference:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-8703447.
2. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth – by Mohandas Karamchand Gandhi.
6. Small is Beautiful – E. F Schumacher.
7. Slow is Beautiful – Cecile Andrews.
8. Economy of Permanence – J C Kumarappa.
9. Bharat Mein Angreji Raj – Pandit Sunderlal.
10. Rediscovering India – by Dharampal.
11. Hind Swaraj or Indian Home Rule – by Mohandas K. Gandhi.
12. India Wins Freedom – Maulana Abdul Kalam Azad.
13. Vivekananda – Romain Rolland (English)

Course Code- 110307 Indian Knowledge System 3 0 0 0

Unit-1.0 7 hrs

Introduction to Indian Knowledge Systems

Overview of IKS, Organization of IKS , Conception and constitution of knowledge in indian tradition,

The oral tradition, Models and Strategies of IKS.

Unit-2.0 **5 hrs**

Overview of IKS Domains

The vedasas the basis of IKS, Overview of all the six vedāṅgas.

Unit-3.0 **8 hrs**

Relevance in Current Technical Education System I

Relevance of following IKS domains in present technical education system: Arthashastra (Indian economics and political systems), Ganitaand Jyamiti(indianmathematics, astronomy and geometry, Rasayana (indianchemical Sciences).

Unit-4.0 **8 hrs**

Relevance in Current Technical Education System II

Ayurveda (Indian Biological Sciences / Diet & Nutrition), JyotishVidya (observational astronomy and calendar systems), PrakritiVidya(indian system of terrestrial/ material sciences/ecology and atmospheric sciences).

Unit-5.0 **7 hrs**

Relevance in Current Technical Education System III

VastuVidya(indian system of aesthetics-iconography and built-environment /architecture), NyayaShastra(indian systems of social ethics, logic and law).

Unit-6.0 **7 hrs**

Shilpa andNatyaShastra (indian classical arts: performing and fine arts), Sankhyaand Yoga Darshna(indian psychology, yoga and consciousness studies), Vrikshayurveda(plant science/sustainable agriculture/food preservation methods).

Text/Reference:-

1. Introduction to Indian Knowledge System: Concepts and Applications, Archak, K.B. (2012)., Kaveri Books, New Delhi, ISBN-13:978-9391818203
2. Introduction To Indian Knowledge System: Concepts and Applications, Mahadevan, B. Bhat, VinayakRajat, NagendraPavana R.N., PHI, ISBN: 9789391818203.
3. Glimpse into Kautilya’ s Arthashastra Ramachandrudu P. (2010) , Sanskrit Academy, Hyderabad, ISBN:9788380171074.
4. “Introduction” in Studies in Epics and Purāṇas, (Eds.), KM Munshi and N ChandrashekaraAiyer BhartiyaVidyaBhavan.

Course Code-110301P Electrical Circuit Analysis Lab 0 0 2 1

Perform the following experiments

List of Experiments:

1. Verification of the Superposition Theorem
2. Verification of Thevenin&Norton Theorem
3. Verification of the Maximum Power Transfer Theorem
4. To Calculate the Characteristics Impedance of T&Pi Network
5. To determine the Driving Point&Transfer Function of a Two-Port Network
6. To study Series, Parallel&Cascade Connection of Two-Port Network
7. To study Series&Parallel Resonance Circuit
8. To study Transient&Steady State Response Of R-L-C Circuit
9. To study the Frequency Response of the Twin T-Notch Filter
10. To study the Z-H Parameter of a Two-Port Network

Course Code-110302P **Digital Electronics Lab** **0 0 2 1**

Perform any 10 Experiments

List of Experiments

1. Study and verify the operation of all logic gates.

2. Design and verify NAND&NOR Gate as a Universalgates.

3. Design and Verify DE Morgan' s Theorem.

4. Design and verity Binary to Gray&Gray to Binary Conversion.

5. Design and verify Half adder circuit&Half Subtractor circuit.

6. Design and Verity Full adder circuit&Full Subtractor Circuit.

7. Study and verify multiplexer and De-multiplexer Circuit.

8. Design and Verity BCD to 7-segment display.

9. Study of Encoder and Decoder circuit

10. Study of characteristics of SR, JK, T&Master-Slave Flip-Flop.

11. Design and Verify shift, register circuit

12. Study and Verity weighted Binary DAC R-2R ladder DAC&Flash ADC

13. Study of Johnson counter&Binary counter.

14. Study of 4-bit Synchronous Up/Down mod-n counter.

Course Code- 110308 Internship – I 02 Weeks (2 Credits)

Internship I Guidelines:

Internship I is of a minimum duration of two weeks which can be completed in an Industry/Institute in consultation with concerned Engineering College/Institute. After completion of Internship a detailed report of the Internship mentioning the training undertaken along with certificate should be submitted.

Semester-IV

Course Code-110401 **Analog Electronics** **3 1 0 4**

Unit-1.0: Diode circuits **6 hrs**

Introduction: Example of an electronic system, basic concept of signal, noise etc. P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit-2.0: BJT circuits **8 hrs**

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model,

biasing circuits, Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load, generation of current source.; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits, Miller' s theorem.

Unit-3.0: MOSFET circuits **8 hrs**

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits-gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit-4.0: Differential, multi-stage and operational amplifiers **6 hrs**

Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier;Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product), Frequency Response of the amplifier.

Unit-5.0: Linear applications of op-amp **8 hrs**

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, +instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, Feedback amplifiers and Oscillators design (Wein bridge and phase shift); multivibrators (astable, monostable& bistable); Analog to Digital Conversion.

Unit-6.0: Nonlinear applications of op-amp **6 hrs**

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot; Design of two-stage amplifier, frequency compensation, generalized structure of multistage amplifier.

Text/ Reference:-

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press,1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley&Sons, 2001.
6. "Fundamentals of Microelectronics", B. Razavi, 2nd Edition.
7. "Microelectronic Circuits", A. S. Sedra and K. C. Smith, 7th Edition

Course Code-110402 Digital Signal Processing 3 1 0 4

Unit-1.0: Discrete and Fast Fourier Transform 8 hrs

The discrete Fourier transform (DFT), Sampling of the discrete time Fourier transform, properties of the DFT, linear convolution using the DFT, Fourier analysis of the signals using the DFT, Direct computation of the DFT, Decimation-in-time FFT algorithms, Decimation-in-frequency FFT algorithm.

Unit-2.0: Design of FIR filters 6 hrs

Design of FIR filters: FIR filters with linear phase, design of FIR filters by windowing and frequency sampling. Design of some special FIR filters, Real Time Implementation of FIR filters.

Unit-3.0: Design of IIR filters 8 hrs

Design of IIR filters: Introduction to IIR filter design, Design of continuous time low pass filters, Butterworth, Chebyshev and Elliptic Approximations; transformation of continuous time filters to discrete time filters, design examples for low pass IIR filters, Frequency transformations of low pass filters.

Unit-4.0: Realisation of Digital filters 6 hrs

Realizations of Digital Filters-FIR filter structures: direct form, cascade form, linear-phase form, FIR Lattice structure. IIR filter structures: direct form-I, direct form-II, cascade form, parallel form, All pole lattice structure, lattice-ladder (pole-zero) lattice structure.

Unit-5.0: Multirate signal processing 8 hrs

Multirate signal processing: sampling rate conversion, implementation of Multirate systems, filter design for Multirate systems

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters:; Low-pass, Band-pass, Band-stop and High pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Unit-6.0: Finite wordlength effects 6 hrs

Finite wordlength effects: Number representation, statistical analysis of quantization error, quantization of Fixed-point and Floating-point numbers, A/D and D/A conversion, A/D conversion noise analysis, quantization of filter coefficients, Effects of finite wordlength on digital filters.

Text/ Reference:-

1. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
   Tarun Kumar Rawat, " Digital Signal Processing", Oxford University Press.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.

4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.

Course Code-110403 **ELECTRICAL MACHINE-1** **3 1 0 4**

Unit-1.0: Basic Concept of Magnetic Circuits **4 hrs**

Concepts of MMF, Flux and reluctance, Electromagnetic induction phenomenon, Magnetic Circuit and application, Elementary machine working principle as motor and generator, Magnetic curves and core losses.

Unit-2.0: Single-Phase Transformers **8 hrs**

Constructional features of Ideal transformer and practical transformer, Principles of operation, Emf equation. Operation on load - magnetizing and core loss components phasor diagrams, equivalent circuit, and determination of its parameters from O.C and S.C tests; Per unit parameter values and their importance; Regulation, efficiency, and all-day efficiency expressions and calculations. Sumpner Test.

Unit-3.0: Three-Phase Transformers **8 hrs**

Constructional features as a single unit and a bank of three units. Vector groups for various connections: Scott connection – Open delta operation, Conversion from three-phase to one-phase, two-phase, and multi-phase, Per-phase analysis; tertiary winding. Parallel operation and load sharing

Types of Transformer: Auto Transformer (saving of copper – rating of autotransformers), Pulse Transformer, Isolation Transformer, Grounding Transformer, power transformer, distribution transformer

Unit-4.0: Basics of Electrical Rotating Machine **6 hrs**

Electromechanical energy conversion Principle: Field energy and co-energy, Torque and force in singly excited and multiple excited electromechanical systems and applications. Windings: Types of winding in DC and AC Machine, MMF in field and armature Winding of machines

Working Principle: Elementary Machine, Torque generation in DC and AC Machine, types of Losses and efficiency in rotating machine

Unit-5.0: DC Machines- Construction and types **8 hrs**

Armature windings – simplex lap and wave windings, pole pitch, coil span, winding pitch, commutator pitch--equalizer ring connections-power flow diagram-numerical problems-dummy coils – methods of setting brushes in DC machines.

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap, and armature core, Commutation; Type of Commutation. air gap flux density distribution, and armature MMF wave.

Type of DC generators and motors; Methods of excitation – separately excited, shunt, series and compound machines. Induced EMF: EMF equations- electromagnetic torque- numerical problems. Derivation of the back EMF equation and torque equation. Armature Reaction; demagnetizing and cross-magnetizing armature MMF; variation with brush position; compensating winding; interpoles-numerical problems

Unit-6.0: DC Machine – Operation&Performance 8 hrs

Armature circuit equation for DC Motor and DC Generator; Types of field excitations, Open circuit characteristic of DC Generator, voltage build-up in a DC Generator, critical field resistance, and critical speed; V-I characteristics and torque-speed characteristics of DC Motors; DC Motor Speed Control. Testing of DC motors -Swinburne's test; Hopkinson's test and retardation test; Calculation of losses and efficiency; DC motor applications.

Parallel operation – parallel operation of shunt series and compound generations

Starting of DC motors- starters – 2 point, 3point and 4 point starters; Speed control of DC motors - field control, armature control; Braking of DC motors- Power flow diagram – losses and efficiency.

Text /Reference:

1. Principles of Electric Machines and Power Electronics, P.C. Sen, 2nd Edition, 2007, Wiley Publication
2. Electrical Machinery, A. E. Fitzgerald, C. Kingsley, S. D. Umans; 6th Edition, 2003, Tata McGraw-Hill
3. AC Machines: Puchstein, Lloyd&Hunte
4. Electrical Machinery, P. S. Bimbhra, Khanna Publishers
5. Electric Machines, I. J. Nagrath&D. P. Kothari, Tata McGraw-Hill Publication

Course Code -110404 Microprocessor and Microcontroller 3 1 0 4

Unit-1.0: Fundamentals of Microprocessors and Microcontrollers 7 hrs

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051family.

Unit-2.0: The 8086 Microprocessor 8 hrs

Introduction to 8086 Microprocessor, Architecture of 8086 Microprocessor, Addressing modes of 8086, Instruction set of 8086, Assembler directives, simple assembly language programs, procedures, and macros. Pin diagram of 8086-Minimum mode and maximum mode of operation.

Unit-3.0: The 8051 Architecture **8 hrs**

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit-4.0: The 8051 Instruction Set and Programming **9 hrs**

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers, Programming and debugging tools.

Unit-5.0: The 8051 Memory and I/O Interfacing **7 hrs**

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices, keyboard and display devices. Interfacing of sensors, transducers, actuators, Data acquisition systems; Standard Interfaces – RS232, USB; Development aids and troubleshooting techniques; Programmable Interrupt and DMA controllers.

Unit-6.0: External Communication Interface **6 hrs**

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Text/ Reference:-

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C" ,Pearson Education,2007.
2. K. J. Ayala, "8051 Microcontroller" , Delmar CengageLearning,2004.
3. R. Kamal, "Embedded System" , McGraw HillEducation,2009.
4. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085" , Penram International Publishing,1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface" , Morgan Kaufman Publishers,2013.
6. D. V. Hall, "Microprocessors&Interfacing" , McGraw Hill Higher Education,1991.

Course Code-110405 Engineering Mechanics 3 0 0 3

Unit- 1.0:

Fundamentals of Mechanics 7 hrs

Overview of engineering mechanics. Vector and scalar quantities. Units of physical quantities. Dimensions of physical quantities. Units and Dimensions. Dimensional analysis.

Unit- 2.0:

Force Systems and Equilibrium 7 hrs

Force Systems Basic Concepts, Particle Equilibrium in 2-D&3-D, Rigid Body Equilibrium, System of Forces: oplanar Concurrent Forces, Components in Space, Resultant and Moment of Forces and its Application, Couples and Resultant of Force System, Free Body Diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

Unit- 3.0:

Friction and Structural Analysis 7 hrs

Types of Friction: Limiting, Static, and Dynamic, Laws of Friction, Motion of Bodies and Wedge Friction, Equilibrium in Three Dimensions, Method of Sections and Method of Joints, Tension and Compression in Members, Simple Trusses, Zero Force Members, Beams, Types of Beams, Frames and Machines.

Unit- 4.0:

Centroid, Centre of Gravity, and Moment of Inertia 7 hrs

Centroid of Simple Figures from First Principle, Centroid of Composite Sections, Centre of Gravity and Its Implications, Area Moment of Inertia: Definition and Theorems Moment of Inertia of Plane Sections, Standard Sections, and Composite Sections, Mass Moment Inertia of Circular Plate, Cylinder, Cone, Sphere, Hook.

Unit- 5.0:

Virtual Work, Energy Method, and Particle Dynamics 7 hrs

Virtual Displacements and Principle of Virtual Work, Degrees of Freedom and Active Force Diagram, Conservative Forces and Potential Energy, Energy Equation for Equilibrium, Applications of Energy Method for Equilibrium, Stability of Equilibrium, Review of Particle Dynamics: Rectilinear and Plane Curvilinear Motion, Relative and Constrained Motion, Newton' s 2nd Law Work-Kinetic Energy, Power, Potential Energy Impulse-Momentum and Impact.

Unit- 6.0: Kinetics of Rigid Bodies 7 hrs

Introduction to Kinetics of Rigid Bodies Basic Terms and General Principles in Dynamics Types of Motion and Instantaneous Centre of Rotation in Plane Motion Simple Problems D' Alembert' s Principle and Its Applications in Plane Motion and Connected Bodies Work-Energy Principle and Its Application in Plane Motion of Connected Bodies Kinetics of Rigid Body Rotation.

Text/ Reference:-

1. Engineering Mechanics statics and dynamics R. C. Hibbeler Pearson Publication, 12th Edition. ISBN-10: 0-13-814929-1 ISBN-13:978-0-13-814929-1

2. Engineering Mechanics statics and dynamics, J. L. Meriam and L. G. Craige, John Willey and Son' s publication. 9th Edition. ISBN: 978-1-119-39098-5
3. Engineering Mechanics, S. P. Timoshenko, D. H. Young, J. V. Rao& S.Pati, McGraw- Hill publication, 5th Edition ISBN-10:9781259062667
4. Engineering Mechanics statics and dynamics, A. K. Dhiman, P. Dhiman&D. Kulshreshtha, McGraw-Hill publication ISBN-10:9789339219178

Course Code-110401P **Analog Electronics Lab** **0 0 2 1**

Perform any 10 Experiments

LIST OF EXPERIMENTS

1. To verify and plot the V-I characteristics of silicon diode& Zener diode in forward and reverse bias.
2. To verify and plot the wave form of half wave rectifier & full wave rectifier
3. To verify and draw input and output characteristics of BJT (PNP or NPN) in CE, CB & CC configuration.
4. To study h- parameter of transistors in C.E configuration, C.B configuration & C.C configuration
5. To study Wein bridge oscillator.
6. To study phase shift oscillator.
7. To study of clipping circuit.
8. To study of clamping circuit.
9. To study of characteristics of MOSFET
10. To study the operational amplifier as differentiator& integrator.
11. To study the operational amplifier as inverting amplifier & non inverting Amplifier.

Course Code-110402P Digital Signal Processing Lab 0 0 2 1

Perform any 10 Experiments

List of Experiment:

1. Computation of N-point DFT of the length-N sequence
2. Evaluation of Fast Fourier Transform using (a) Decimation in Time algorithm (b)Decimation
3. in Frequency algorithm
4. Design of FIR Low pass, High pass, Band pass and Band stop filters using rectangular and Bartlett window.
5. Design of FIR Low pass, High pass, Band pass and Band stop filters using (i) Blackman
6. window (ii) Hamming window (iii) Hanning window
7. Design of IIR Digital- (i) Low pass (ii) High pass (iii) Band pass (iv) Band stop filter using Butterworth approximation
8. Design of IIR Digital (i) Low pass (ii) High pass (iii) Band pass (iv) Band stop filter using
9. CHEBYSHEV TYPE-I approximation and CHEBYSHEV TYPE-II approximation.
10. Cascade realization of the given Linear-Phase FIR/ IIR transfer functions
11. Decimation and interpolation and poly phase decomposition
12. Sampling and reconstruction of a band limited signal

The experiments are to be done on DSP trainer kit/ MATLAB environment

Course Code-110403P ELECTRICAL MACHINE-I Lab 0 0 2 1

Perform the following Experiments

List of Experiments:

1. Experiment to determine self and mutual inductances of two coupled inductors
2. Open circuit and short circuit tests on a single-phase transformer and determination of parameters.
3. Calculating the regulation and efficiency of a Single-Phase transformer
4. Parallel Operation of Two Single-Phase Transformers
5. Study of different types of transformers

6. Vector Group Test of the Three-Phase Transformer
7. Determination of the characteristics of a DC Shunt Generator
8. Determination of the efficiency of the DC machine through Hopkinson's Test
9. Study of DC Shunt, DC Series, and DC Compound Machines
10. Speed Control of DC Motor using armature voltage and field control

Course Code-110404P **Microprocessor and Microcontroller Lab** **0 0 2 1**

Perform any 10 Experiments

List of Experiments:

1. Programs for 16/8 bit arithmetic operations for 8086/8085 (using Various Addressing Modes).

2. Program for sorting an array for 8086.
3. Program for searching for a number or character in a string for 8086.
4. Program for string manipulations for 8086.
5. Program for digital clock design using 8086.
6. Interfacing ADC and DAC to 8086 / 8051.
7. Interfacing stepper motor to 8086 / 8051.
8. Programming using arithmetic, logical and bit manipulation instructions of 8051.
9. Program and verify Timer/ Counter in 8051.
10. Program and verify Interrupt handling in 8051
11. UART Operation in 8051.
12. Communication between 8051 kit and PC.

Course Code-110406 **NPTEL (Open Course)** **12 Weeks (3 Credits)**

NPTEL (Open Course) Guidelines:

NPTEL (Open Course) should be taken from the course other than core subjects of the branch.

Semester-V

Course Code-110501 Power System-I 3 1 0 4

Unit-1.0: Introduction to Power System 6 hrs

Introduction to Power System, Introduction to Conventional and Renewable Energy Sources,Single Line Diagram, Per-Unit representation of Power system– Selection of base quantities, percent and per unit values, advantage of per unit system

Unit-2.0: Transmission line parameters 10 hrs

Resistance, Inductance, Capacitance, and Conductance. Inductance of single-phase line, inductance of three-phase line with symmetrical and unsymmetrical spacing, concept of GMD and GMR. Inductance of composite conductor systems – stranded conductors, bundle conductors, and Double circuit lines. Capacitance of single-phase line, capacitance of three-phase lines with symmetrical and unsymmetrical spacings, capacitance calculation for double circuit line and bundle conductor. Effect of the Earth on capacitance calculation. Skin effect, proximity effect, and Ferranti effect. Interference between power and communication lines.

Unit -3.0: Line Representation 6 hrs

Representation of short, medium, and long lines, Pi and T models. ABCD constant of transmission lines and their measurement. Travelling wave interpretation of long line equations, tuned lines.

Unit -4.0: Transmission line structure 8 hrs

Types of conductors, line supports – poles, towers, stay,&Guy wires, Sag and Tension calculations, stringing chart, sag template. Insulators – Materials of insulators, types of insulators – Pin and Disc type – their applications. Underground Cables – Construction of cables, single and multicore cables, different types, capacitance of belted cables, dielectric loss in cables, heating of cables.

Unit -5.0: Aspects of Electrical Supply 6 hrs

Legal aspects of electricity supply- Electricity acts, rules, and codes. Standards followed in power supply, environmental, and safety measures Commercial aspects of electricity supply –

Expenditure in the power Utility. Factors influencing tariffs, types of consumers, and different types of tariffs. Administrative aspects of electricity supply- Development of power sector in India. Administrative set up and organisations in the power sector.

Unit -6.0: HVDC Transmission **6 hrs**

Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of an HV DC system. Line Commutated Converter and Voltage Source Converter-based systems

Text/ Reference:-

1. Power System Analysis, John J. Grainger & William D. Stevenson Jr, McGraw Hill1994;
2. Power System Analysis and design, J. Duncan Glover, M. Sarma, 2nd edition, PWS Publishing Co Boston 2001;
3. Power System Engineering, D. P. Kothari & I. J. Nagrath, Tata McGraw Hill, 2008.

Course Code-110502 Electrical Machines – II 3 1 0 4

Unit- 1.0: Fundamentals of AC machine windings **6 hrs**

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.

Unit- 2.0: Pulsating and revolving magnetic fields **7 hrs**

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit- 3.0: Induction Machines **8 hrs**

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines; Linear Induction Machine

Unit- 4.0: Single-phase AC motors **4 hrs**

Single-phase induction motor: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications; Universal Series Motor

Unit-5.0: Synchronous machines **11 hrs**

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division; starting and speed control of synchronous motors.

Unit-6.0: Special Electric Machines **6 hrs**

Reluctance Machines: Synchronous reluctance, stepper motors, and switched reluctance machines, principles of operation and models for operating characteristics. Steady-state and dynamic performance.

PM machines: Basic analysis of magnetic circuit with permanent magnets, Steady-state and dynamic performance of PM synchronous machines, and Brushless DC machines. Servo Motors: Working principle and applications

Text/ Reference:-

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery" , McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines" , CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery" , Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines" , McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines" , McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics" , John Wiley&Sons, 2007.

Course Code-110503 **Control System** **3 1 0 4**

Unit- 1.0: Introduction to control problem **4 hrs**

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit- 2.0: Time Response Analysis **9 hrs**

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based

on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit- 3.0: Frequency-response analysis **7 hrs**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit- 4.0: Introduction to Controller Design **9 hrs**

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit-5.0: State variable Analysis **7 hrs**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Unit- 6.0: Introduction to Optimal Control and Nonlinear Control **5 hrs**

Performance Indices. Regulator problem, Tracking Problem. Nonlinear system– Basic concepts and analysis.

Text/ Reference:-

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. K.Ogata, "Modern Control Engineering", Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

Course Code-110504 Analog & Digital Communication System 3 0 0 3

Unit- 1.0: 7 hrs

Introduction to Communication Systems: Basic building blocks of communication systems, Review of probability and random process, Gaussian and white noise characteristics, power spectral density of noise, noise through LTI systems.

Unit- 2.0: 6 hrs

Analog Modulation: Need for modulation, Amplitude Modulation (AM), frequency division multiplexing, spectrum of AM, DSBSC, SSB-SC and VSB-SC. AM transmitters and receivers. Angle Modulation, spectrum of angle modulated signal, Noise in AM and FM systems, Pre-emphasis and De-emphasis, Threshold effect in angle modulation; Transmission Bandwidth of FM signals, Methods of generation and detection. FM Transmitters and Receivers.

Unit- 3.0: 6 hrs

Pulse Modulation: Sampling theorem and time-division multiplexing - Pulse Modulation Techniques - PAM, PWM and PPM concepts - PCM system – Data transmission using analog carriers (ASK, FSK, BPSK, QPSK), generation and detection of pulse modulation.

Unit- 4.0: 7 hrs

Error control coding techniques – Linear block codes- Encoder and decoder. Cyclic codes – Encoder, Syndrome Calculator. Convolution codes. Modern Communication Systems – Microwave communication systems - Optical communication system - Satellite communication system - Mobile communication system.

Unit- 5.0: 8 hrs

Digital Transmission at Baseband: Quantization, pulse code modulation, line codes, spectral characteristics of line codes, Matched filter receiver, inter-symbol interference, eye-patterns, Nyquist' s criterion for ISI free transmission, equalization.

Unit- 6.0: 8 hrs

Digital Transmission at Passband: Binary digital modulation, QAM, signal constellation, spectral characteristics of digital modulated signals, digital receiver design - correlator receiver, optimal detectors, bit error rate performance analysis over AWGN channels, power and bandwidth efficiency.

Text/ Reference:-

1. Simon Haykins, 'Communication Systems' , John Wiley, 3rd Edition, 1995.
2. D.Roddy & J.Coolen, 'Electronic Communications' , Prentice Hall of India, 4th Edition, 1999.
3. Kennedy G, 'Electronic Communication System' , McGraw Hill, 1987.

Open Elective Course-I

Course Code-110507 Object Oriented Programming 3 0 0 3

Unit- 1.0: 4 hrs

Introduction to C++ : Object Oriented Technology, Advantages of OOP, Input- output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types. The void data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.

Unit- 2.0: 6 hrs

Control Structures and Functions: Decision making statements like if-else, Nested if-else, goto, break, continue, switch case, Loop statement like for loop, nested for loop, while loop, do-while loop.

Unit- 3.0: 6 hrs

Parts of Function, User- defined Functions, Value- Returning Functions, void Functions, Value Parameters, Function overloading, Virtual Functions.

Unit- 4.0: 8 hrs

Classes and Data Abstraction : Structure in C++, Class, Build- in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects (Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.

Unit- 5.0: 8 hrs

Overloading, Templates and Inheritance: Operator Overloading, Function Overloading, Function Templates, Class Templates. Single and Multiple Inheritance, virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function.

Unit- 6.0: 10 hrs

Pointers, Arrays and Exception Handling: Void Pointers, Pointer to Class, Pointer to Object, Void Pointer, Arrays. The keywords try, throw and catch. Creating own Exception Classes, Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), Stack Unwinding.

Text/ Reference:-

1. Thinking in C++, Volume 1 & 2 by Bruce Eckel, Chuck Allison, Pearson Education

Mastering C++, 1/e by Venugopal, Tata McGraw Hill.
2. Object Oriented Programming with C++, 3/e by E. Balaguruswamy, Tata McGraw Hill.
Starting Out with Object Oriented Programming in C++, by Tony Gaddis, Wiley India.
3. The C++ Programming language 3/e by Bjarne Stroustrup, Pearson Education.
4. C++, How to Programme, 4e, by Deitel, Pearson Education.
5. Big C++ by Cay Horstmann, Wiley India.
6. C++ Primer, 3e by Stanley B. Lippmann, JoseeLajoie, Pearson Education.
7. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI.
8. Programming with C++, 2/e by Ravichandran, Tata McGraw Hill.
9. C++ Programming Black Book by Steven Holzner, Dreamtech Press.

Course Code-110508 **Operating System** **3 0 0 3**

Unit- 1.0: **6 hrs**

Introduction and history of Operating systems: Structure and operations; processes and files; Computer system organization (Computer Hardware) consists of Device, Device controller, Interrupt, Device and CPU interaction, Bootstrap program.

Unit- 2.0: **6 hrs**

I/O structure: Polling, interrupt, and DMA, resolve interrupt through interrupt vector, Computer System Architecture, Single Processor System, Multiple Processors System, advantages of using multiple processor system, Operating System Structure and Operations, Dual Modes operation, Timer, Process management, Storage management.

Unit- 3.0: **6 hrs**

Processes: Processor management: inter process communication, mutual exclusion, semaphores, wait and signal procedures, process scheduling and algorithms, critical sections, threads, multithreading; Process concept, PCB, Process state, Process scheduling (long, medium- and short-term schedulers), Process operations, Inter process communication, Techniques of Intercrosses communication, Message passing, Shared memory, Client server

Unit- 4.0: **8 hrs**

CPU scheduling: Preemptive and non-preemptive scheduling, scheduling criteria, algorithms: FCFS, SJF, Prediction of next burst of SJF, Priority Scheduling, Round Robin, Multilevel Queues, Multilevel feedback. Process Synchronization: Introduction and background, Critical section (C.S.) problem,

Condition for the solutions of C.S., Algorithms: Peterson, Hardware solutions, Semaphores, Monitors.

Unit- 5.0: **8 hrs**

Main Memory Management :-Memory management: contiguous memory allocation, Basic Hardware for managing Memory, Address binding, Contiguous allocation (based on fixed and variable partitions), Relocation and protection problems, Fragmentation, Non- contiguous allocation. Virtual memory, paging, paging hardware support page table structure, demand paging, page replacement policies, thrashing, Segmentation, Paging with Segmentation.

Unit- 6.0: **8 hrs**

Deadlock: Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms.

Device management - devices and their characteristics, device drivers, device handling, disk scheduling algorithms and policies File management: file concept, types and structures, directory structure, cases studies, access methods and matrices, file security, user authentication; File Systems: -File system structure, Implementation, Partition and mounting, Allocation methods: Contiguous, Linked, Indexed Free space Management: Bit vector, Linked list

Case Studies: UNIX and Linux operating systems as case studies; Mobile OS

Text/ Reference:-

1. A. Silberschatz & P.B. Galvin, Operating System concepts and principles ‘, Wiley India.
2. A. Tanenbaum, Modern Operating Systems ‘, Prentice Hall India
3. W. Stallings,_ Operating Systems: Internals and design Principles ‘, Pearson Ed.,
4. M.J. Bach, Design of Unix Operating system ‘, Prentice Hall,

Course Code-110509 **Computer Architecture** **3 0 0 3**

Unit- 1.0: **8 hrs**

Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance.

Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques; Compiler techniques for improving performance.

Unit- 2.0: **8 hrs**

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.

Unit- 3.0: **6 hrs**

Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures. Array and vector processors.

Unit- 4.0: **6 hrs**

Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared memory architecture**:**

Unit- 5.0: **6 hrs**

synchronization, memory consistency, interconnection networks. Distributed shared memory architecture. Cluster computers.

Unit- 6.0: **8 hrs**

Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.

Text/ Reference:-

1. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.
4. W. Stallings, "Computer organization", PHI, 1987.
5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012.
6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.
7. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India, 1986.
8. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987.
9. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991.
10. P. Able, "8086 Assembly Language Programming", Prentice Hall India.

Course Code-110510 **Sales and Marketing** **3 0 0 3**

Unit- 1.0: **6 hrs**

Introduction to Sales and Marketing

- **What is Marketing?** Definition, importance, and evolution of marketing concepts.
- **What is Sales?** Definition, role of sales in a business, and the relationship between sales and marketing.
- **Marketing Mix (4Ps):** Product, Price, Place (Distribution), and Promotion.
- **Consumer Behavior:** Understanding consumer motivations, buying decisions, and factors influencing purchasing.

Unit- 2.0: **8 hrs**

Market Analysis and Strategy

- **Market Segmentation, Targeting, and Positioning (STP):** Identifying target markets, developing positioning strategies.
- **Market Research:** Understanding the purpose of market research, types of research methods, and data analysis.
- **Competitive Analysis:** Identifying competitors, analyzing their strengths and weaknesses, and developing competitive strategies.
- **Strategic Marketing Planning:** Developing marketing plans, setting objectives, and measuring performance.

Unit- 3.0: **7 hrs**

Sales Management and Techniques

- **Sales Processes and Strategies:**
  Understanding different sales strategies, lead generation, and sales techniques.
- **Sales Force Management:**
  Recruiting, training, motivating, and managing sales personnel.
- **Customer Relationship Management (CRM):**
  Understanding the importance of CRM, managing customer interactions, and building strong relationships.
- **Sales Communication and Negotiation:**
  Developing effective communication skills, negotiation techniques, and closing sales.

Unit- 4.0: **8 hrs**

Marketing Communication and Promotion

- **Advertising:**
  Understanding different advertising media, campaign planning, and media buying.
- **Sales Promotion:**
  Understanding different types of sales promotions, couponing, and loyalty programs.
- **Public Relations (PR):**
  Building positive relationships with the public, media relations, and crisis communication.
- **Digital Marketing:**
  Understanding online marketing channels, social media marketing, SEO, and email marketing.

Unit- 5.0: **7 hrs**

- **Product and Brand Management:**

Developing and managing product lines, branding strategies, and brand equity.

- **Pricing Strategies:**
  Understanding different pricing methods, pricing objectives, and pricing policies.

Unit- 6.0: **6 hrs**

- **Distribution Channels:**
  Understanding different distribution channels, logistics, and supply chain management.
- **Ethics in Sales and Marketing:**

Understanding ethical issues in sales and marketing, and responsible marketing practices.

Text/Reference:-

1. K.S. Chandrasekar, MARKETING MANAGEMENT TEXT AND CASES, Tata McGraw-Hill Publication, New Delhi.2010
2. Govindarajan, MARKETING MANAGEMENT CONCEPTS, CASES, CHHALLENGES AND TRENDS, Prentice Hall of India, New Delhl. 2009
3. Philip Kotler, MARKETING MANAGEMENT- ANALYSIS PLANNING AND CONTROL, Prentice Hall of India, New Delhi,
4. Ramaswamy. V S&Namakumari. S, MARKETING MANAGEMENT-PLANNING IMPLEMENTATION AND CONTROL, Macmillan Business Books, New Delihi, 2002,
5. Balaram Dogra&Karminder Ghuman, RURAL MARKETING: CONCEPT&CASES, Tata McGraw-Hill Publishing Company, New Delhi, 2008
6. Ravi Shanker, SERVICES MARKETING: THE INDIAN PERSPECTIVE, Excel Books, New Delhi, 2008

Course Code- 110506 **Indian Constitution** **3 0 0 0**

Unit- 1.0: **7 hrs**

The Indian Constitution; meaning, genesis of the Indian Constitution, Preamble-Salient features, Components, types of Constitution, Functions, Basic Structure of the Constitution, Constitutionalism.

Unit- 2.0: **6 hrs**

The Union and its Territory, Citizenship, Fundamental Rights, and Fundamental Duties, Directive Principles of State Policy

Unit- 3.0: **8 hrs**

The Union Territory; The Panchayats, The Municipalities, Composition, Wards,Cooperative societies, definition, number and term of members of Board and its Office Bearers, relationship between the Union and the State, The SC and ST- Affirmative Action

Unit- 4.0: **9 hrs**

Organs of Government; The Executive, The Legislative Union, and The Judiciary. The States; The Executive, The Governor – Executive Power of the State, Appointment of Governor, Terms of Office of Governor, Qualifications for appointment as Governor, conditions of Governor' s Office, Council of Ministers, Duties of Chief Minister, Judiciary High Court, Subordinate High Court

Unit- 5.0: **6 hrs**

Relation between the Union and the State; Legislative relations, and administrative relations. Finance, Property, Contracts, Rights, Liabilities, Obligations, Suits, Right to Property

Unit- 6.0: **6 hrs**

Official Language of the Union .Amendment of the Constitution; Power of Parliament to amend the Constitution and procedure.

Text/ Reference:-

1. Agarwal, R., C, (1977). Indian Political System. New Delhi. S. Chand & Company.
2. Basu, D., D. (2008). Introduction to the Constitution of India. New Delhi. Prentice Hall of India.
3. Chakravarthy, B. (2008). Indian Constitution and Politics. New Delhi. Sage India.
4. Ghosh, Peu. (2017). Indian Government and Politics. New Delhi. Prentice Hall of India Learning.
5. Pandey, J., N. (2018). The Constitution of Law of India. Allahabad, Central Law Agency.
6. Pylee., M., V. (2005). An Introduction to the Constitution of India. 4th Edition. New Delhi. Vikas Publishing House.

Course Code-110501P **Power System-I Lab** **0 0 2 1**

Perform the following Experiments

LIST OF EXPERIMENTS

1.To ABCD parameter of a Transmission line.
2.To determine voltage distribution and string efficiency of suspension insulator with guard ring and without guard ring.
3. To study load test on Transmission line and calculation of regulation.
4.To study the efficiency of the Transmission line through load test.
5.To study Ferranti effect and calculation of charging current of transmission lines at load test.
6. To study the shunt reactor compensation of transmission lines.
7.To study the shunt capacitive compensation of transmission lines. to improve voltage profile.
8. To study the parallel operation of transmission lines.

Course Code-110502P **Electrical Machine – II Lab** **0 0 2 1**

Perform the following Experiments

LIST OF EXPERIMENTS

1. Study of the three-phase Induction motor starting methods
2. Determination of equivalent circuit parameters of a three-phase induction Motor

3. To perform a load test on a single-phase squirrel-cage Induction motor
4. To perform a load test on a three-phase squirrel-cage Induction motor
5. To perform a load test on a three-phase slip ring induction motor
6. To perform the speed control on a three-phase squirrel cage Induction motor
7. To perform the operation of a three-phase synchronous motor by varying the field excitation at different mechanical loading
8. Determination of OCC, SCC, and ZPF characteristics of a 3-phase Synchronous Machine
9. Determining the V-curve of a Synchronous Machine
10. To study the operation of a synchronous generator at NO load and Full load

Course Code-110503P **Control System Lab** **0 0 2 1**

Perform the following Experiments

List of Experiments:

1. To study the potentiometer as an error detector.
2. To study the PID controller for an oven.
3. To study the synchro transmission-receiver&output v/s input characteristics.
4. To study the characteristics of a small A.C. servomotor.
5. Determine the transient response of a 2nd order system.
6. To study the performance of an Analog PID controller using a simulated system.
7. To study the behavior of DC-separated excited motors at open-loop and closed-loop control systems.

Course Code-110504P Analog&Digital Communication System Lab 0 0 2 1

Perform any ten Experiments

LIST OF EXPERIMENTS

1. Study of Modulating Frequency Generation.
2. Study of Carrier Frequency Generation
3. Amplitude modulation using DSB TC modulator.
4. Amplitude demodulation of DSBTC modulator using envelope detector.
5. Amplitude modulation using SSB SC modulation.
6. Amplitude demodulation of SSB SC modulator using product detector.
7. Amplitude modulation with DSB SC modulator.
8. Amplitude demodulation of DSB SC modulation using product detector.
9. Study of Superheterodyne Receiver.
10. Study of ASK modulation and demodulation.
11. Study of FSK modulation and demodulation.
12. Study of PSK modulation and demodulation.
13. Study of QPSK modulation and demodulation.

Course Code-110505 **Internship- II** **4 Weeks (4 Credits)**

Internship- II Guidelines:

Internship II is of a minimum duration of four weeks which can be completed in an Industry/Institute in consultation with concerned Engineering College/ Institute. After completion of internship a detailed report of the internship mentioning the training undertaken along with certificate should be submitted.

Semester-VI

Course Code-110601 Power Electronics 3 1 0 4

Unit- 1.0: Power switching devices 9 hrs

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a Thyristor; Gate drive circuits for MOSFET and IGBT.

Unit- 2.0: Thyristor rectifiers 8 hrs

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge Thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit- 3.0: DC-DC Converter 4 hrs

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage

Unit- 4.0: Buck-Boost converter 6 hrs

power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of

output voltage.

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit- 5.0: Single-phase voltage source inverter **8 hrs**

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.

Unit- 6.0: 3-phase voltage source inverter **7 hrs**

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation. Current Source Inverter.

Text/ Reference:-

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley&Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science&Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

Course Code-110602 **Power System – II** **3 1 0 4**

Unit- 1.0: Power Flow Analysis **7 hrs**

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications.

Unit- 2.0: Application of numerical methods **6 hrs**

Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Unit- 3.0: Stability Constraints in synchronous grids **8 hrs**

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three— phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraintson Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Unit- 4.0: Control of Frequency and Voltage **8 hrs**

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.

Power flow control using embedded dc links, phase shifters and

Unit- 5.0: Monitoring and Control **7 hrs**

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control

Unit- 6.0: Fault Analysis and Protection Systems **6 hrs**

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Text/ Reference:-

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw HillEducation,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

Course Code-110603 Electrical and Electronics Measurement 3 1 0 4

Unit-1.0: Measurement and Error 8 hrs

Measurement and Error: Definition, Accuracy and Precision, Significant Figures, Types of Errors. Standards of Measurement: Classification of Standards, Electrical Standards, IEEE Standards. Types of measuring instrument: Ammeter and Voltmeter: Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction type Ammeters and Voltmeters. Energy meters and wattmeter.: Construction, Theory and Principle of operation of Electro-Dynamometer and Induction type wattmeter, compensation, creep, error, testing, Single Phase and Poly phase Induction type Watt-hour meters. Frequency Meters: Vibrating reed type, electrical resonance type, Power Factor Meters.

Unit-2.0: Measurement of Resistance, Inductance and Capacitance 7 hrs

Resistance: Measurement of Low Resistance by Kelvin' s Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Meg ohm meter), Measurement of Insulation Resistance when Power is ON, Measurement of Resistance of Earth Connections. Inductance: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges(Maxwell' s, Hay' s, & Anderson Bridge), Measurement of Mutual Inductance by Felici' s Method, and as Self Inductance. Measurement of Capacitance by various methods.

Unit-3.0: Galvanometer & Potentiometer 7 hrs

Galvanometer: Construction, Theory and Principle of operation of D' Arsonval, Vibration(Moving Magnet&Moving Coil types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers, Galvanometer Constants, Measurement of Flux and Magnetic Field by using Galvanometers. Potentiometer: Construction, Theory and Principle of operation of DC Potentiometers (Crompton, Vernier, Constant Resistance,&Deflection Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).

Unit-4.0: Current Transformer and Potential Transformer 4 hrs

Current Transformer and Potential Transformer :Construction, Theory, Characteristics and Testing of CTs and PTs.

Unit-5.0: Electronic Instruments for Measuring Basic Parameters 9 hrs

Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters: Introduction, Ramp type, Dual slope integrating type (V– T), integrating type (V– F) and Successive approximation type (relevant problems). Q-meter Oscilloscope: Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay using Oscilloscope.

Unit-6.0: Digital Instruments **7 hrs**

Introduction, Block diagram of a Basic Digital Multimeter; Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement, Signal generator; Analog-to-Digital Conversion (ADC), Stair case Ramp Compensation, Integrator-based ADC, Delta-Pulse-Modulation-based ADC.

Text/ Reference:-

1. Electrical Measurements and Measuring Instruments – Golding& Widdis – 5th Edition, Reem Publication.
2. Modern Electronic Instrumentation and Measurement Techniques – Helfrick & Cooper – Pearson Education.
3. A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.
4. Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata McGraw Hill.
5. Electronic Measurement and Instrumentation – Oliver&Cage – Tata McGraw Hill.

Course Code-110604 **Entrepreneurship and Startups** **3 0 0 3**

Unit- 1.0: Introduction to Entrepreneurship **7 hrs**

Objective: Understand the fundamental concepts of entrepreneurship.

Learning Outcomes:

o Define entrepreneurship and its significance.

o Explore historical perspectives on entrepreneurship.

o Identify key theories related to entrepreneurship.

Unit- 2.0: Idea Generation and Evaluation **7 hrs**

Objective: Develop skills in generating and evaluating business ideas.

Learning Outcomes:

o Generate innovative business ideas.

o Apply criteria for evaluating the feasibility and viability of ideas.

o Understand the role of creativity and problem-solving in idea generation.

Unit- 3.0: Business Planning **7 hrs**

Objective: Learn how to create effective business plans.

Learning Outcomes:

o Develop a business plan covering marketing, human resources, and operations.

o Understand financial planning and projections.

o Explore the use of AI and technology in business planning.

Unit- 4.0: Financing and Funding **7 hrs**

Objective: Explore financing options for startups.

Learning Outcomes:

o Understand different sources of funding (e.g., bootstrapping, venture capital, angel investors).

o Evaluate the pros and cons of each funding method. o Create a financial plan for a startup.

Unit- 5.0: Field Work and Projects **7 hrs**

Objective: Apply theoretical knowledge to real-world scenarios.

Learning Outcomes:

o Conduct field research (interviews, surveys, observations) related to entrepreneurship.

o Collaborate on group projects that simulate startup challenges.

o Present findings and recommendations.

Unit- 6.0: Case Studies and Contemporary Topics **7 hrs**

Objective: Analyze real-world case studies and explore current trends.

Learning Outcomes:

o Analyze entrepreneurial success stories and failures.

o Discuss contemporary topics (e.g., sustainability, social entrepreneurship, disruptive technologies).

o Reflect on ethical considerations in entrepreneurship.

Text/ Reference:-

1. "The Lean Startup" by Eric Ries
2. "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" by Bill Aulet
3. "Venture Deals: Be Smarter Than Your Lawyer and Venture Capitalist" by Brad Feld and Jason Mendelson
4. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2019). Entrepreneurship (10th ed.). McGraw-Hill Education.
5. Blank, S. G., & Dorf, B. (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch Inc
6. "Blue Ocean Strategy" by W. Chan Kim and Renée Mauborgne.
7. "Business Model Generation" by Alexander Osterwalder and Yves Pigneur.
8. "Business Plans for Dummies" by Paul Tiffany and Steven D. Peterson.
9. "Operations Management" by Jay Heizer and Barry Render.
10. "Human Resource Management" by Gary Dessler.
11. "Venture Deals" by Brad Feld and Jason Mendelson.
12. "Financial Intelligence for Entrepreneurs" by Karen Berman and Joe Knight.
13. "The Innovator's Dilemma" by Clayton Christensen.
14. "Zero to One" by Peter Thiel.
15. "Good to Great" by Jim Collins.
16. Entrepreneurship 11th Edition by Robert Hisrich, McGraw-Hill Higher Education, Year 2020, Print ISBN 9781260043730, 1260043738, eText ISBN 9781260564112, 1260564118
17. Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Expanded&Updated 2nd Edition by Bill Aulet
18. Entrepreneurship: The Practice and Mindset 2nd Edition by Heidi M. Neck; Christopher P. Neck; Emma L. Murray, SAGE Publications, Inc, Print ISBN 9781544354620, 1544354622, e-text ISBN 9781544354644, 1544354649, Year2021

Program Elective Course-I

Course Code-110606 Electrical Machines Design 3 0 0 3

Unit- 1.0: 6 hrs

Introduction: Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space

factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications.

Unit- 2.0: **8 hrs**

Transformer: Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

Unit- 3.0: **8 hrs**

Induction motors: Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.

Unit- 4.0: **8 hrs**

Synchronous machines: Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length –

Unit- 5.0: **6 hrs**

Design of rotor of Synchronous Design – Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.

Unit- 6.0: **6 hrs.**

Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation

Text/ Reference:-

1. A Course in Electrical Machine Design, A.K. Sawhney, Dhanpat rai and sons.
2. Electrical machine design, V. rajini, V.S. Nagarajan, Pearson India education services Pvt. Ltd.
3. Computer Aided Design of Electrical Machine, K. M. V. Murthy, B.S. Publications.
4. Design and Testing of Electrical Machines, M.V.Deshpande, PHI
5. Principles of Electrical Machine Design, 3rd Edition, S.K. sen, Oxf-Ibh
6. Computer Aided Design of Electrical Equipment, M. Ramamoorthy, East-West Press.

Course Code-110607 ELECTRICAL DRIVES 3 0 0 3

Unit-1.0: Fundamentals of Electric Drive 8 hrs

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of load. Load torque: components, nature and classification

Unit-2.0: Dynamics of Electric Drives 6 hrs

Dynamics of motor-load combination, Steady state stability of Electric Drive, Transient stability of electric Drive. Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty, Load equalization.

Unit-3.0: Electric Braking 10 hrs

Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors. Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.

Unit-4.0: Power Electronic Control of DC Drives 8 hrs

Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited dc motor and dc series motor.

Unit-5.0: Power Electronic Control of AC Drives 5 hrs

Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based) static rotor resistance and slip power recovery control schemes.

Unit-5.0: Self-controlled scheme Drives 5 hrs

Three Phase Synchronous motor: Self-controlled scheme Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications.

Text/ Reference:-

1. G.K. Dubey, “Fundamentals of Electric Drives” , Narosa publishing House.
2. S.K.Pillai, “A First Course on Electric Drives” , New Age International.
3. M.Chilkin, “Electric Drives” ,Mir Publishers, Moscow.
4. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives” , Thomson Asia, Pvt. Ltd.

Singapore.
5. N.K. De and Prashant K.Sen, "Electric Drives", Prentice Hall of India Ltd.
6. V.Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill.

Course Code- 110608 Process Control System 3 0 0 3

Unit- 1.0: Controller Principle **6 hrs**

Introduction, Process-Control Block Diagram, manipulated variable, Controlled variable, Uncontrolled variable. Process Characteristics, Process Equation, Process Load, Process Lag, Self-Regulation.

Unit- 2.0: Control System Parameters **10 hrs**

Error, Variable Range, Control Range, Control Lag, Dead Time, Cycling. Controller Modes: Discontinuous Controller Modes: Two-Position (ON/OFF) Mode, Multi-position Mode, Floating Control Mode. Continuous Controller Modes: Proportional Control Mode, Integral Control Mode, Derivative Control Mode, Composite Control Mode, Proportional-Integral (PI) Control Mode, Proportional-Derivative (PD) Control Mode, Proportional- Integral- Derivative (PID) Control Mode

Unit- 3.0: Analog Controllers **7 hrs**

Introduction, General features, Design of electronic controllers: Error Detector, ON/OFF controller, Proportional controller, Integral controller, derivative controller, PI controller, PD controller, PID controller.

Unit- 4.0: Control loop Characteristics **7 hrs**

Introduction, Control system configurations, feed forward, single, multivariable, Ratio, Split range, Inferential and cascade control system. Control system quality, stability. Process loops tuning: Open-Loop Transient Response Method and Ziegler-Nichols Method.

Unit- 5.0: Computer-Aided process control **6 hrs**

Introduction, Role, Elements, Architecture, and classification. Man-Machine Interface, Economics of Computer-Aided Process Control, Benefits of Using Computers in a Process Control. Process related interfaces: Analog, digital, pulse and standard interfaces. Design of digital control algorithms - dead beat.

Unit- 6.0: Process and Instrumentation Drawing&Diagrams **6 hrs**

Objectives, Characteristics, Line Symbols, Identification Letters, Valve Symbols, General Instrument or Function Symbols, Transmitter Symbols, Miscellaneous Symbols Interlock logic symbols. Graphic symbols. Representation of process loops using P and ID symbols.

Text/ Reference:-

1. Curtis D. Johnson Process Control Instrumentation Technology, PHI, 8th Edition, 2014
2. S K Singh Computer Aided Process Control, PHI, 2004
3. Stephano Poulos G Chemical Process Control: An Introduction to Theory and Practice, PHI. 2015

Course Code-110609 **Electrical Materials** **3 0 0 3**

Unit- 1.0: Conductivity of Metal **8 hrs**

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

Unit- 2.0: Dielectric Properties of Materials **8 hrs**

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity.

Unit- 3.0: Magnetic properties of Materials **6 hrs**

Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and

hysteresis loss, common magnetic materials, magnetic resonance.

Unit- 4.0: Semiconductors **6 hrs**

energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

Unit- 5.0: Insulating Materials and their applications **8 hrs**

Plastics: Definition and classification, Thermosetting materials: Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins - their important properties and applications, Thermo-plastic materials: Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications.

Unit- 6.0: Special Materials **6 hrs**

Thermocouple, bimetals, lead soldering and fuse material, mention their applications, Introduction of various engineering materials necessary for fabrication of electrical machines such as motors, generators, transformers.

Text/Reference:-

1. Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi.
2. Electrical Engineering Materials by Sahdev, Unique International Publications.
3. Electrical and Electronic Engineering Materials by SK Bhattacharya, Khanna Publishers, New Delhi.
4. Electrical Engineering Materials by PL Kapoor, Khanna Publishers, New Delhi.

Course Code-110610 **Electrical Safety** **3 0 0 3**

Unit-1.0: Electrical Hazards and Electrical Safety Equipment and Electrical Safety Procedures **8 hrs**

The Importance of Electrical Safety, Basic Rules of Electrical Safety, Electric Shock, Personal Protective Equipment, Lockout Devices. Electrical Fires and type of fire extinguishers.

Unit-2.0: Earthing, Earth Faults, and Short Circuits **8 hrs**

Basics of Equipment and Sytem Earthing, Types of Earthing, Equi-potential bonding, Protection Against Earth Faults in LV circuits, Earth fault loop impedance, Static Electricity Grounding

Through Enclosures

Unit-3.0: Protection against over current in LV circuits and equipment **8 hrs**

Protection against Overload currents, Short circuit currents, Current carrying Capacities of conductors, Cable selection. Protection schemes of Motors and transformers. Lightning, and surge protection in LV systems

Unit- 4.0: Various protective devices **6 hrs**

Isolation, Switching, Control, Protective and Monitoring Devices. Fuses MCBs, MCCBs, RCCBs. Various tests like Continuity, Insulation resistance, Phase sequence etc.

Unit- 5.0: Testing of LV circuits **4 hrs**

Isolation, Switching, Control, Protective and Monitoring Devices. Fuses MCBs, MCCBs, RCCBs. Various tests like Continuity, Insulation resistance, Phase sequence etc.

Unit- 6.0: Protection scheme in HT system **8 hrs**

Substation and Transmission line protection, Transformer protection, Under frequency Protection for load shedding or Islanding scheme. Various Relays and schemes used for overlapping protection

Text/Reference:-

1. Safety in Electrical Low Voltage Installations Vol 1 – 8, CAMTECH RDSO.
2. Electrical Safety of Low Voltage Systems by Massimo Mitolo, 1st Edition, 2009 The McGraw-Hill.
3. Power System Protection and Switchgear by Badri Ram and D. N. Vishwakarma 3rd Edition,

Open Electives Courses-II

Course Code- 110611 Embedded System 3 0 0 3

Unit- 1.0: Introduction to Embedded Systems 8 hrs

Embedded systems Overview, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics of embedded computing applications, Design Challenges, Common Design Metrics

Unit- 2.0: Embedded System Development 7 hrs

Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs. Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems.

Unit- 3.0: Interface 6 hrs

Sensors and Actuators, Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer Communication Interface: Onboard and External Communication Interfaces.

Unit- 4.0: Embedded system Program 6 hrs

Embedded Firmware, ARM processor Architecture, pipeline, registers, instructions, thumb mode, exceptions Embedded Firmware Design Approaches and Development Languages.

Unit- 5.0: Real-Time Operating Systems 8 hrs

Architecture of the kernel, Tasks and Task Scheduler, Scheduling algorithms, Interrupt Service Routines, Semaphores, Mutex, Mailboxes, Overview of off-the shelf operating systems-Micro C/OS II, VxWorks, RT

Unit- 6.0: Overview of Hardware and Software 7 hrs

co design Fundamental Issues in Hardware-Software co-design, Computation models in Embedded system design, Introduction to Unified Modeling Language (UML).

Text/Reference:-

1. Introduction to Embedded Systems -Shibu K.V, McGrawHill
2. Embedded Systems Design – Santanu Chattopadhyay, PHI, 2nd Edition, 2013.
3. Embedded System Design -Frank Vahid, Tony Givargis, JohnWiley
4. An Embedded Software Primer -David E. Simon, Pearson Education.
5. Embedded/Real-Time Systems: Concepts Design and Programming, K.V.K.K. Prasad Dreamtech,2005
6. Embedded Systems – Lyla, Pearson,2013

Course Code-110612 Introduction to Python Programming 3 0 0 3

Unit- 1.0: Fundamentals of Python Programming 8 hrs

Introduction to Python, Installing and Writing Python Program, Data types in Python: Comments, Doc strings, Variables, Data types, Built-in data types, bool, Sequences, Sets, Literals, Characters, User-defined Data types, Constants, Identifiers, Reserved words, Naming Conventions. Operators in Python: Arithmetic, Assignment, Unary Minus, Relational, Logical, Boolean, Bitwise, Membership, Identity, Operator Precedence and Associativity, Mathematical Functions. Input and Output, Control Statements: Control Statements, if, if else while, for, break, continue.

Unit- 2.0: Arrays 8 hrs

Arrays in Python: Introduction, Creating, Importing Array Module, Indexing, Slicing, Processing, Types, Working with Arrays using NumPy, Creating Arrays using array (), Mathematical Operations, Comparing, Aliasing, Viewing, Copying, Slicing and Indexing in NumPy Arrays, Dimensions, Attributes, reshape and flatten methods.

Unit- 3.0: Functions, Strings 7 hrs

Functions: Difference between a Function and a Method, Defining, Calling, Returning Results and Multiple Values, Pass by Object Reference, Formal and Actual, Positional, Keyword, Default, Variable Length Arguments, Local and Global Variables.

Unit- 4.0: Lists, Tuples, Dictionaries 7 hrs

Lists and Tuples: List, Creating Lists using range () Function, Operations on Lists, Nested Lists, List Comprehensions, Tuples, Creating Tuples, Accessing Tuple Elements, Basic Operations on Tuples, Nested Tuples, Inserting, Modifying and Deleting Elements from a Tuple. Dictionaries- Operations on Dictionaries, Dictionary Methods.

Unit- 5.0: Oops Concepts 6 hrs

Introduction to Oops: Problems in Procedure Oriented Approach, Specialty of Python, Features of Object-Oriented Programming systems (OOPS); Classes and Objects-Creating a Class, The Self Variable, Constructor.

Unit- 6.0: Inheritance and Polymorphism: 6 hrs

Constructors in Inheritance, Overriding Superclass Constructors and Methods, super () Method, Types of Inheritance, Polymorphism.

Text/Reference:-

1.Core Python Programming – 3rd edition, Dr R Nageshwar Rao, dreamtech press, 2016
2.Python programming, Ch Satyanarayana, M Radhika mani, B N Jagadish, University Press, 2018.

Course Code- 110613 Internet of Things 3 0 0 3

Unit- 1.0: Basics of Networking 8 hrs

Introduction, Network Types, layered network models Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components

Unit- 2.0: IoT Sensing and Actuation 6 hrs

Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

Unit- 3.0: IoT Processing Topologies and Types: 8 hrs

Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

Unit- 4.0: Associated IoT Technologies 8 hrs

Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service.

Unit- 5.0: IOT Case Studies Agricultural IoT 4 hrs

IOT Case Studies Agricultural IoT – Introduction and Case Studies.

Unit- 6.0: IOT Case Studies and Future Trends Vehicular IoT 8 hrs

IOT Case Studies and Future Trends Vehicular IoT – Introduction Healthcare IoT – Introduction, Case Studies IoT Analytics – Introduction

Text/Reference:-

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press
3. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
4. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Course Code-110614 **Entrepreneurship and Venture Development** **3 0 0 3**

Unit- 1.0: **8 hrs**

Introduction:

Concept and Definitions Entrepreneurship, Entrepreneurial Mind-set, Traits/Qualities of Entrepreneurs, Entrepreneurship process; Theories of entrepreneurship; Factors affecting the emergence of entrepreneurship; Role of an entrepreneur in economic growth as an innovator; Generation of employment opportunities; complementing and supplementing economic growth; Bringing about social stability and balanced regional development of industries.

Unit- 2.0: **6 hrs**

Types of Entrepreneurs:

Classification and Types of Entrepreneurs; Women Entrepreneurs; Social Entrepreneurship;

Corporate Entrepreneurs, Family Business: Concept, structure, and kinds of family firms; Culture and evolution of family firm; Managing Business.

Unit- 3.0: **7 hrs**

Business plan:

Creating Entrepreneurial Venture: Generating Business ideas, Team building, Sources of Innovation, Creativity, and Entrepreneurship; Challenges in managing innovation; Entrepreneurial strategy and Scaling up, Business planning process; Drawing business plans; Failure of the business plan.

Unit- 4.0: **6 hrs**

Mobilizing Resources:

Resource Mobilization for entrepreneurship: Resources mobilization, types of resources, Process of resource mobilization, Arrangement of funds; writing a Funding Proposal, Traditional sources of financing, Venture capital, Angel investors, Business Incubators.

Unit- 5.0: **9 hrs**

Managerial Aspects of Business and Government Initiatives:

Managing finance; Understanding capital structure; organisation structure and management of human resources of a new enterprise; Marketing-mix; Management of cash; Relationship management; Cost management, Government initiatives for promoting entrepreneurship. Exercises: The learners are required to: 1. Discuss various cases of entrepreneurship and distinguish between different entrepreneurial traits. 2. Prepare a business plan for a start-up venture in a rural setting after analyzing the various facets of the rural economy. 3. Analyse and present the key initiatives of the government of india for promoting entrepreneurship in the country in a business area. 4. Analyse and interpret case study on business philosophy at Tata Group, Aditya Birla Group, Reliance Industries Limited, and similar organisations. 5. Participate in business plan competition-designing a business plan proposal and identifying alternative sources of raising finance for the start-ups.

Unit- 6.0: **6 hrs**

Experiential Learning and Capstone Projects:

Workshops and Case Studies: Hands-on workshops and case studies provide students with practical
experience in various entrepreneurial aspects.

Internships and Mentorship: Students may have opportunities to gain practical experience through Internships or mentorship programs.

Capstone Projects: A capstone project allows students to apply their knowledge and skills to develop
and implement a business plan or prototype.

Text/Reference:-

1. Barringer, B.R., & Ireland, R.D. (2015). Entrepreneurship. Pearson.

2. Gersick, K. E., Davis, J. A., Hampton, M. M.,&Lansberg, I. (1997). Generation to generation: Life cycles of the family business. Boston, United States: Harvard Business School Press.
3. Hisrich, R.D., Manimala, M.J., Peters, M.P., & Shepherd, D.A. (2013). Entrepreneurship. Delhi, India: Tata McGraw Hill.
4. Kuratko, D.F.,&Rao, T. V. (2012). Entrepreneurship: A South-Asian Perspective .Cengage.
5. Shukla, M.B. (2007). Entrepreneurship and Small Business Management. Allahabad, India: Kitab Mahal Publishers.
6. Nicholls, A. (Ed.). (2006). Social entrepreneurship new models of sustainable social change. London: United Kingdom: Oxford University Press. 3
7. Hishrich, R.D.,&Peters, M.P.(2017), Entrepreneurship. Delhi, India: Tata McGraw Hill.
8. Scarborough, N. M., Cornwall, J. R., & Zimmerer, T. (2016). Essentials of entrepreneurship and small business management. Boston, United States: Pearson.
9. Shankar, R. (2012). Entrepreneurship Theory and Practice. Delhi, India: Tata McGraw Hill.

Course Code- 110601P Power Electronics Lab 0 0 2 1

Perform the following Experiments

LIST OF EXPERIMENTS

1. Study of characteristics of SCR, MOSFET, IGBT, DIAC&TRIAC characteristics.
   - To plot V-I characteristics of SCR.
   - To study the output and transfer characteristics of MOSFET.
   - To study the output and transfer characteristics of the IGBT.
   - To study the output and transfer characteristics of DIAC.
   - To study the output and transfer characteristics of TRIAC.
2. To study the characteristics of DC-DC CHOPPER.
   - Buck converter
   - Boost converter
   - Buck-boost converter
3. To study the single-phasecontrolled and uncontrolled AC-DC converter (Bridge rectifier).
   - Single-phase half-wave rectifier
   - Single-phase full-wave rectifier
4. To study the three-phase controlled and uncontrolled AC-DC converter (Bridge rectifier)
5. To study the single-phase cycloconverter.
6. To obtain the performance characteristics of a single-phasevoltage source inverter.
7. To obtain the performance characteristics of a three-phase voltage source inverter.
   - 120-degree conduction and 180-degree conduction
8. To study various SCR commutation techniquesfor CLASS-A, CLASS-B, CLASS-C, CLASS-D, CLASS-E, and CLASS-F.
9. To study the gate or base drive triggering circuit.
   - SCR and MOSFET
10. To study the flyback converter.

Course Code-110602P **Power Systems – II Lab** **0 0 2 1**

Perform the following Experiments

LIST OF EXPERIMENTS

1.Formulation of Z-Bus.
2. Formulation of Y-Bus.
3.Load flow analysis using Gauss Seidel Method.
4. Load flow analysis using Newton Raphson Method
5. To study the symmetrical faults – Three Phase short circuit fault analysis
6. To study unsymmetrical faults- Single line to ground fault analysis
7. To study unsymmetrical faults- double line to ground fault analysis
8. To study unsymmetrical faults- line to line fault analysis

Course Code-110603P **Electrical and Electronics Measurement Lab** **0 0 2 1**

Perform the following experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of Low Resistance using Kelvin' s double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic wave forms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.
9. Current Measurement using Shunt, CT, and Hall Sensor.

Course Code-110605 **NPTEL-II (Core Courses)** **12 Weeks (3 Credits)**

NPTEL (Core Course) Guidelines:

NPTEL (Core Course) should be taken from the core subjects of the branch.

SEMESTER VII

Program Elective Course-II

Course Code- 110702 Power System Analysis and Stability 3 0 0 3

Unit-1.0: **7 hrs**

Nonlinear systems Power Systems as non-linear, basic equations of the power system as Ordinary Differential Equations (ODE), Differential Algebraic Equations (DAE), Equilibrium points: Definition, Linearization. Eigen analysis, Stability regions.

Unit-2.0: **8 hrs**

Angle Stability and Voltage Stability and the Relationship between two, types of blackouts, voltage collapse, transmission congestion, Availability based tariff, Voltage Compensation, and reactive power contribution to stability, Flexible AC transmission.

Unit-3.0: **6 hrs**

Power system stabilizers, lead-lag design, Angle stability, and equal area criterion.

Unit-4.0: **8 hrs**

Numerical problems on equal-area criterion, critical clearing time, Synchronous machine response to small-signal perturbation, Small-signal response of machines with voltage regulator, Gain margin, phase margin of single machine infinite bus system (SMIB) systems.

Unit-5.0: **4 hrs**

Transient stability study of synchronous machines

Unit-6.0: **9 hrs**

Bifurcations in swing models of power systems and application of non-linear dynamics tools. Numerical analysis tools like Runga-Kutta for solving nonlinear equations.

Text/Reference:-

1. A. R. Bergen and V. Vittal, Power systems analysis, Second Edition, Prentice-Hall, 2000.
2. J. Arrillaga and C. P. Arnold, Computer analysis of power systems, John Wiley, 1990.
3. P. Kundur, Power System Stability and Control, McGraw-Hill, 1994, ISBN 0-07- 035958-X.
4. P. M. Anderson and A. A. Fouad, Power system control and stability, IEEE Press, 1994.
5. C. A. Cañizares, Editor, "Voltage stability assessment: concepts, practices and tools," IEEE-PES Power System Stability Subcommittee Special Publication, SP101PSS, May 2003.

Course Code-110703 Power System Operation and Control 3 0 0 3

Unit-1.0: Preliminaries on Power System Operation and Control 8 hrs

Power scenario in Indian grid, National and Regional load dispatching centres, requirements of good power system, necessity of voltage and frequency regulation, real power vs frequency and reactive power versus voltage control loops, system load variation, load curves and basic concepts of load dispatching, load forecasting, bus classification, nodal admittance matrix - Load flow equations, Iterative methods, Gauss and Gauss Seidel methods, Newton-Raphson method, Fast Decoupled method.

Unit-2.0: Automatic Voltage Regulator 6 hrs

Basics of generator control loops, cross-coupling between control loops, exciter types, exciter modelling, generator modelling, turbine modelling, speed governing mechanisms and modelling, static performance of AVR loop.

Unit-3.0: Automatic Load Frequency Control (ALFC) 8 hrs

Automatic load frequency control of single area system, static and dynamic analysis of uncontrolled and controlled cases, load frequency control of two are system, tie-line modelling, block diagram representation of two are system, static and dynamic analysis, tie-line with frequency bias control.

Unit-4.0: Economic Operation of Power System 6 hrs

Statement of economic dispatch problem, input and output characteristics of thermal plant, incremental cost curve, optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients), base point and participation factors method, statement of unit commitment (UC) problem, constraints on UC problem, solution of UC problem using priority list, special aspects of short term and long term hydrothermal problems.

Unit-5.0: Reactive Power and Voltage Control 8 hrs

Generation and absorption of reactive power, basics of reactive power control, Automatic Voltage Regulator (AVR), brushless AC excitation system, block diagram representation of AVR loop, stability compensation, voltage drop in transmission line, methods of reactive power injection, tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

Unit-6.0: Computer Control of Power System 6 hrs

Need of computer control of power systems, concept of energy control centres and functions, Phase Measurement Unit (PMU), system monitoring, data acquisition and controls, SCADA and EMS functions, state estimation problem, measurements and errors.

Text/Reference:-

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction' , McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control' , John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control' , PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.
4. Kothari D.P. and Nagrath I.J., 'Power System Engineering' , Tata McGraw-Hill Education, Second Edition, 2008.
5. Hadi Saadat, 'Power System Analysis' , McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
6. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

Course Code-110704 **Electric Vehicle** **3 0 0 3**

Unit-1.0: Energy Conversions Principles **8 hrs**

Concept of work power&energy and its unit kinetic and potential energy, Scalar and vector, Torque, Circular and Periodic motion. Concept of Energy, Kinetic and Potential energy, Electrical energy-power-equivalent systems. Energy conversion from mechanical to electrical and vice-versa. Conservation of energy and momentum principles.

Unit-2.0: Vehicle Architecture and Sizing **6 hrs**

Electric Vehicle History, and Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Micro and Mild architectures. Mountain Bike - Motorcycle- Electric Cars and Heavy Duty EVs. -Details and Specifications.

Unit-3.0: Vehicle Mechanics **8 hrs**

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire – Road mechanics, Propulsion System Design.

Unit-4.0: Power Components and Brakes **6 hrs**

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

Unit-5.0: Hybrid Vehicle Control Strategy **6 hrs**

Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

Unit-6.0: PLC Programming **8 hrs**

Introduction- History-Comparison with electrical and hybrid electrical vehicle- Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

Text/Reference:-

1. Mehrdad Ehsani, YiminGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric

and Fuel Cell Vehicles: Fundamentals, Theory and Design" , CRC Press, 2004.

2. "Build Your Own Electric Vehicle,Seth Leitman" , Bob Brant, McGraw Hill, Third Edition 2013.
3. "Advanced Electric Drive Vehicles" , Ali Emadi, CRC Press, First edition 2017.
4. "The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles" , Mark Warner, HP Books, 2011.

Course Code-110705 Industrial Electrical System 3 0 0 3

Unit-1.0: Electrical System Components 8 hrs

LT system wiring component, Cable, wire, switch, distribution box, metering system selection, Tariff structure and billing Protection devices: Fuse, MCB, MCCB, ELCB, Inverse current characteristics, Electrical symbols and single line diagram (SLD) of a wiring system, Contactors, Isolators, Relays, MPCB Electric shock prevention and electrical safety practices.

Unit-2.0: Residential and Commercial Electrical Systems 8 hrs

Residential/commercial wiring systems and installation rules Load calculation, wire sizing, switch rating, DBs Protection device rating, and placement Earthing systems, and calculations, Lighting scheme planning and number of luminaires Component selection for commercial installations.

Unit -3.0: Illumination Systems 6 hrs

Lighting terms: lumen, intensity, candle power, efficiency. Illumination design parameters: glare, depreciation, space-height ratio Lamps: incandescent, CFL, LED – operation and efficiency

Lighting system design for buildings and flood lighting Energy-saving techniques in lighting design.

Unit-4.0: Core Industrial Systems 8 hrs

HT connection and substation layout in industries, Transformer selection and industrial motor loads, Motor starting methods, and industrial SLD design, Cable and switchgear selection, Lightning protection and earthing Power factor correction: KVAR calculation and compensation PCC and MCC panels

Unit-5.0: Power Backup and Auxiliary Systems 6 hrs

DG systems and UPS, Electrical systems for elevators and HVACs, Battery banks: selection and sizing DG, UPS sizing for industrial applications, Load management during outages.

Unit-6.0: Industrial Electrical System Automation & Emerging Trends 6 hrs

Basics of PLCs and role in automation PLC-based control system design Panel metering Introduction to SCADA for monitoring and distribution automation Real-life case studies (1– 2 industries) Overview of emerging trends: IoT, smart metering.

Text/Reference:-

1. S. K. Bhattacharya – *Industrial Electrical Systems*
2. J. B. Gupta – *Utilization of Electric Power and Electric Traction*
3. M. K. Giridharan – *Electrical Systems Estimating and Costing*
4. Timothy L. Skvarenina – *Industrial Electricity*
5. IEEE/IEC/BIS Standards and Codes
6. OEM Documentation for PLC, DG, UPS systems

Course Code- 110706 HVDC Transmission System 3 0 0 3

Unit- 1.0: 6 hrs

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.

Unit- 2.0: **7 hrs**

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.

Unit- 3.0: **8 hrs**

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.

Unit- 4.0: **7 hrs**

Converter faults and protection: Converter faults, Protection against over-currents, Overvoltages in a converter station, Surge arresters, Protection against over-voltages.

Unit- 5.0: **6 hrs**

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.

Unit- 6.0: **8 hrs**

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 and 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.

Text/ Reference:-

1. HVDC Power transmission systems, K.R. Padiyar, Third Edition, New Age International Publishers
2. Power Transmission by Direct Current, Erich Uhlmann, Fourth Indian Reprint, Springer International Edition, 2012.
3. HVDC Transmission, S Kamakshaiah, V Kamaraju, 2nd Edition, Mcgraw Hill Education, 2020.
4. Direct Current Transmission, E.W.Kimbark, Wiley– Blackwell; Volume 1 edition (1 January 1971)
5. H.V.D.C Transmission, J Arrillaga, 1st Edition, The Institution of Engineering and Technology, 1998

Program Elective Course -III

Course Code-110707 Power Plant Engineering 3 0 0 3

Unit- 1.0: 7 hrs

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates. Sub systems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

Unit- 2.0: 5 hrs

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants.

Unit- 3.0: 8 hrs

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit- 4.0: 9 hrs

Hydroelectric power plants, Hydrological cycle, Rainfall&run-off measurement&plotting of various curves for estimating stream flow, site selection, classification, comparison with other types of power plant, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.

Unit- 5.0: 8 hrs

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Unit- 6.0: 5 hrs

Geothermal power plants, Ocean thermal electric conversion,, M.H.D power generation.

Text/ Reference:-

1 Power Plant Engineering, 5th Edition,, Laxmi Publications(P) Ltd
2 Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
3 El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
4 Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

Course Code- 110708 Wind and Solar Energy System 3 0 0 3

Unit-1.0: Physics of Wind Power 7hrs

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit-2.0: Wind generator topologies 9hrs

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit-3.0: The Solar Resource 6hrs

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit-4.0: Solar photovoltaic 7hrs

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit-5.0: Network Integration Issues 8 hrs

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybridand isolated operations of solar PV and wind systems.

Unit.6.0: Solar thermal power generation 5 hrs

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text/ Reference:-

1. T. Ackermann Wind Power in Power Systems John Wiley and Sons Ltd., 2005.
2. G.M. Masters, Temewable and Efficient Electric Power Systems John Wiley and Sons, 2004.
3. S.P. Sukhatme, Solar Energy : Principles of Thermal Collection and Storage, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, grid intergration of wind energy conversion systems John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M.k. Ghosal Renewable Energy Applications Narosa Publication, 2004.
6. H.A. Duffie and W.A. Beckman, Solar Engineering of Thermal Processes, John Wiley and Sons,1991.

Course Code-110709 Power System Protection&Switchgear 3 0 0 3

Unit-1.0: Over view of Power System Protection 4 hrs

General architecture of protection system, Evolution of relays, Attributes of a protection system, Current and potential transformer for relays, Zones of protections, Concept of primary and back-up protection.

Unit-2.0: Over current Protection 8 hrs

Construction, Operating Principle and Characteristics of Instantaneous overcurrent relay, Definite Time over current relay, Inverse Time over current relay, Inverse definite minimum time over current relay Co-ordination of over current relays for radial lines, Over current protection of three-phase feeder Construction, Operating Principle and Characteristics of Directional over current relay, Directional over current protection of a three-phase feeders Drawbacks of over current protection.

Unit-3.0: Transmission Line Protection 10 hrs

Universal Torque Equation, Construction, Operating Principle and Characteristics of Simple Impedance relay, Reactance relay, and Mho relay, Directional properties of various impedance relays, Distance protection of a three-phase line, Three-stepped distance protection.

Unit-4.0: Differential Protection Scheme **8 hrs**

Dot convention, Simple differential protection– behaviour during normal load, external fault and internal fault Actual behaviour of a simple differential protection scheme and Percentage Differential relay. Differential protection of bus bars, actual behaviour of a protective current transformer – effect of CT saturation.

Unit-5.0: Transformer Protection **4 hrs**

Over-current protection, Percentage differential protection of transformer, Inrush phenomenon, percentage differential relay with harmonic restraint, Inter-turn faults in transformer, Buchholz relay Protection against over-fluxing.

Unit.6.0: Circuit Breaker and Digital Relay **8 hrs**

Requirement of circuit breakers, Characteristics of electric arc, Principle of AC and DC arc interruption, recovery and Restriking voltage. Interruption of capacitive currents, Various types of circuit breakers - Air-breaker circuit breaker, bulk-oil circuit breaker and minimum oil circuit breaker, Air-blast circuit breaker, SF6 circuit breaker, Vacuum circuit breaker. Architecture of a digital relay, Phasor Measurement technique, Numerical distance protection of transmission line.

Text/Reference:-

1. Y. G. Paithankar and S. R. Bhinde, Fundamentals of Power System Protection, PHI
2. Stanley H. Horowitz, Arun G. Phadke, James K. Niemira, Power System Relaying, Willey
3. J. L. Blackburn and T. J. Domin, Protecive Relaying: Priciples&Applications, CRC Press
4. S. S. Rao, Switch Gear and Protection, Khanna Publishers

Course Code- 110710 Smart Grid Technology 3 0 0 3

Unit-1.0: Smart Grid Basics **4 hrs**

Evolution of electric power grid and smart grid, objectives and main features. Key technology areas and challenges of smart grid.

Unit-2.0: Energy Resources **9 hrs**

Centralized vs. distributed generation; renewable energy: solar, wind, hydropower, biomass, geothermal, ocean wave; benefit, costs, and policies of renewable energy; renewable sources integration – overcoming intermittence; storage systems technology.

Unit-3.0: Demand-side Management 9 hrs

Load profile of the power grid; market pricing; peak shaving and valley filling; load forecasting; regulations and policies.

Unit-4.0: Smart Grid Communication 7 hrs

Two-way digital communication paradigm, network architectures, IP-based systems, power line communications, advanced metering infrastructure (AMI).

Unit-5.0: Monitoring and Protection 9 hrs

Sensor networks, wide area measurement, systems (WAMS), phasor measurement units (PMUs), communications infrastructure, fault detection and self-healing systems, application and challenges; Security and Privacy: cyber security challenges in smart grid, defense mechanism, privacy challenges.

Unit-6.0: Plug-in Electric Vehicle (PEV). 4 hrs

EV and electric power grid; PEV charging infrastructure, challenges and solutions; PEV as an energy storage device and an energy source (V2G)

Text/ Reference:-

1. James Momoh *'Smart Grid: Fundamentals of Design and Analysis'* Wiley-IEEE Press, 2012.
2. Phillip F. Schewe *'The Grid: A Journey through the Heart of our Electrified World'* Joseph Henry Press, 2006.
3. J. Duncan Glover, Mulukutla S. Sarma, and Thomas J. Overbye, *Power System Analysis and Design*, 4th Ed.,Stamford, CT: Cengage Learning, 2008.
4. Jan Machowski, JanuszBialek, and James R. Bumby, *Power Systems Dynamics, Stability and Control*, 2nd Ed.New York, New York: John Wiley, 2008.
5. B. Droste-Franke, et al., *Balancing Renewable Electricity – energy storage, demand side management, and network extension from an interdisciplinary perspective*. Heidelberg, Germany: Springer, 2012.
6. I. Hussain, Electric and Hybrid Vehicles : Design Fundamentals, 3rd Ed., CRC Press, 2021.

Course Code- 110711 Electrical Energy Conservation and Auditing 3 0 0 3

Unit-1.0: Energy Scenario 7 hrs

Renewable and non-renewable energy, Indian energy scenario, integrated energy policy, energy intensity on purchasing power parity, Energy sector reforms, energy and environment, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features.

Unit-2.0: Energy Management & Audit 7 hrs

Definition, energy audit, need, types of energy audit and approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel&energy substitution, energy audit instruments.

Unit-3.0: Energy Efficiency in Electrical Systems 8 hrs

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement benefits, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Unit-4.0: Energy Efficiency in Industrial Systems 8 hrs

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC.

Unit 5.0- Fans and blowers 4 hrs

Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Unit 6.0- Energy Efficient Technologies in Electrical Systems 8 hrs

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/ Reference:-

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online).
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).
3. S. C. Tripathy, — Utilization of Electrical Energy and Conservation‖ , McGraw Hill, Reprint 1991.

4. W.R. Murphy& G. Mckey Butterworths, "Energy Management" , New Age International Publishers, 2007.
5. Amit kumar Tyagi, Hand book on Energy Audit and Management, TERI (Tata Energy Research Institute).

Open Electives Courses-III

Course Code-110712 **AI and Machine Learning** **3 0 0 3**

Unit-1.0: **6 hrs**

Artificial Intelligence, Application of AI, AI Problems, Problem Formulation, Intelligent Agents, Types of Agents, Agent Environments, PEAS representation for an Agent, Architecture of Intelligent agents. Reasoning and Logic, Prepositional logic, First order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining.

Unit-2.0: **8 hrs**

Search Strategies: Solving problems by searching, Search- Issues in The Design of Search Programs, Un-Informed Search- BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Alpha beta search algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis

Unit-3.0: **6 hrs**

Artificial Neural Networks : Introduction, Activation Function, Optimization algorithm Gradient decent, Networks-Perceptrons, Adaline, Multilayer Perceptrons, Back propogation Algorithms Training Procedures, Tuning the Network Size.

Unit-4.0: **8 hrs**

Introduction to ML: Machine Learning basics, Applications of ML, Data Mining Vs Machine Learning vs Big Data Analytics. Supervised Learning-NaïveBase Classifier, Classifying with k-Nearest Neighbour classifier,Decision Treeclassifier, Naïve Bayes classifier. Unsupervised Learning - Grouping unlabeled items using k-means clustering, Association analysis with the Apriori algorithm Introduction to reinforcement learning

Unit-5.0: **8 hrs**

Forecasting and Learning Theory : Non-linear regression, Logistic regression, Random forest, Baysian Belief networks, Bias/variance tradeoff, Tuning Model Complexity, Model Selection Dilemma Clustering : Expectation-Maximization Algorithm, Hierarchical Clustering, Supervised Learning after

Clustering, Choosing the number of clusters, Learning using ANN

Unit-6.0: **6 hrs**

Introduction, Optimal Separating Hyperplane, Separating data with maximum margin, Support Vector Machine (SVM),Finding the maximum margin, The Non-Separable Case: Soft Margin Hyperplane, Kernel Trick, Defining Kernels Ensemble Methods :Mixture Models, Classifier using multiple samples of the data set, Improving classifier by focusing on error, weak learner with a decision stump, Bagging, Stacking, Boosting ,Implementing the Ada Boost algorithm, Classifying with Ada Boost Bootstrapping and cross validation

Text/ Reference:-

1. Python for data analysis, Wes McKinney,O' reilly, 3rd edition
2. Ethem Alpaydın, "Introduction to Machine Learning", Second edition, MIT Press, 2010.
3. Tom M Mitchell, "Machine Learning", McGraw-Hill Science, 1st edition, 2017
4. Stephen Marsland, Machine Learning, An Algorithmic Perspective, 2e, CRC Press, 2015
5. Giuseppe Bonaccorso, Machine Learning Algorithms, 1e, Packt Publishing Limited, 2017
6. Ethem Alpaydin, Machine Learning- The New AI, MIT Press, 1e, 2016

Course Code- 110713 Industrial Automation and Control 3 0 0 3

Unit-1.0: **6 hrs**

Introduction of Automation system Introduction to Industrial Automation, Requirement of automation systems, Application areas, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial communication protocols: modbus & profibus

Unit-2.0: **10 hrs**

Automation using relay logic Relay Circuits: Construction & Principle of Operation, Types of Relays, Relay as a memory element, Contactor Circuits, Advantages of Contactors over Relay, DOL circuit implementation using contactor, Automation problems based on relays, PLC Introduction: History & Current Trends, Basic Block Diagram of PLC, Classification of PLCs

Unit-3.0: **8 hrs**

Automation using PLC Types of PLC I/O: Analog and Digital, Sink and Source concept, PLC programming: Ladder diagram, Sequential flow chart, ladder programming, Timer instructions – On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, math instructions

Unit-4.0: **6 hrs**

Industrial sensors and its application Introduction to Industrial sensors: optical, inductive, capacitive Sensors, PNP and NPN senor concept, interfacing of sensors with PLC, 4-20 ma current loops, HART

protocol, modes of HART protocol

Unit-5.0: **6 hrs**

Basics of Pneumatics and its use in automation Introduction to Pneumatics, Role in industries, Laws: Boyel' s law, Charle' s Law Bernoulli Equation, Humidity (Absolute & Relative) , Dew Point (ADP, PDP)

Unit-6.0: **6 hrs**

Basic, Pneumatic System (Compressor, After coolers, Dryers, Air Tank, Service Unit (FRL), Actuators (single acting, double acting), Valves : 2/2 & 3/2 Valves ,Problems based on valves and actuator

Text Books:

1. Industrial Instrumentation and Control, by Singh, McGraw Hill.
2. Programmable Logic Controllers with Control Logix, by Jon Stenerson, Delmar Publishers, 2009
3. Webb John W. and Reis A. Ronald, "Programmable Logic Controllers Principles and Applications" PHI ,New Delhi, Latest edition
4. Bolton W, "Programmable Logic Controllers" Elsevier India Pvt. Ltd. New Delhi
5. B. Pneumatic Systems-Principles and Maintenance Mazumdar S. R
6. John R Hackworth, "Programmable Logic Controllers" Pearson education New Delhi, Latest edition

Course Code-110714 **Biomedical and Instrumentation** **3 0 0 3**

Unit-1.0: **8 hrs**

Biomedical signals and Physiological transducers: Source of biomedical signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG and EEG Physiological transducers: Pressure, Temperature, photoelectric and ultrasound Transducers.

Unit-2.0: **10 hrs**

Measurement in Respiratory system: Physi- ology of respiratory system, Measurement of breathing

mechanics Spiro meter, Respiratory therapy equipments Inhalators ventilators and Respirators, Humidifiers, Nebulizers Aspirators, Biomedical recorders: ECG, EEG and EMG.

Unit-3.0: **6 hrs**

Patient Monitoring systems and Audiometers: Cardiac monitor, Bed-side patient monitor, measurement of heart rate, blood pressure, temperature, respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity.

Unit-4.0: **4 hrs**

Audiometers: Audiometers, Blood cell counters, Oximeter, Blood flow meter, cardiac output measurement, Blood gas analyzers.

Unit-5.0: **8 hrs**

Modern Imaging systems: Introduction, Basic principle and Block diagram of x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (NMR), ultrasonic imaging system. Eco-Cardiograph, Eco Encephalography, Ophthalmic scans, MRI. Therapeutic Equipments: Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, Surgical diathermy machine.

Unit-6.0: **6 hrs**

Patient' s safety: Precaution, safety codes for electro medical equipment, Electric safety analyzer, Testing of biomedical equipment, Ultrasound therapy unit. Electrotherapy Equipments, Ventilators.

Text Books :

1 "Hand book of Biomedical Instrumentation" , R.S.Khandpur, TMH
2 "Biomedical Instruments: Theory and Design" , Walter Welko- Witiz and Sid Doutsch, Wiley
3 "Biomedical Instrumentation and Measurements" , Lesile Cromwell, Fred J. Weibell and Erich A. Pfeiffer, PHI
4 "Introduction to Biomedical Equipment Technology" , Joseph J. Carr and John M. Brown, Pearson
5 "Textbook of Biomedical Instrumentation System" , Shakti Chatterjee, Cengage Learning

Open Electives Courses-IV

Course Code-110715 Computer Network 3 0 0 3

Unit-1.0: 6 hrs

Introduction: Layer approach, Fundamentals of physical layer, Performance metrics: delay, loss, throughput, bandwidth delay product, latency.

Unit-2.0: 7 hrs

Link Layer: Fundamentals of error detection, CRC, retransmission strategies, multiple access protocols, random access techniques, FDMA, TDMA, CDMA, Reservation, polling, token ring and buses, High speed LANs.

Unit-3.0: 7 hrs

Network Layer: Internetworking, Tunneling, Encapsulation, Fragmentation, Internet protocol and its operation, Routing algorithms distance vector and link state algorithm and Routing protocols.

Unit-4.0: 9 hrs

Transport Layer: Transmission Control Protocol, Flow control, Error control, Congestion control, Header, Services, Connection management, Timers, Congestion control; User Datagram Protocol, Introduce low latency protocols (WebRTC, LHLS), Applications (IoT and FOG, Real-time applications, ad-hoc wireless protocols).

Unit-5.0: 6 hrs

Applications: Network programming, Socket abstraction, Peer-to-peer architecture (P2P architecture), Client server architecture, DNS, HTTP, FTP, SMTP, TelNet, etc.

Unit-6.0: 7 hrs

Advanced Internetworking: Multicast routing, Queuing disciplines and buffer management techniques. Network security: Public key and private key cryptography, Digital signature, Firewalls.

Text/ Reference:-

1. Data Communication and Networking, B. A. Forouzan, Mc Graw Hill, 2017, Fifth Edition
2. Computer Networking – A top down approach featuring the Internet, J.F. Kurose and K. W. Ross, Pearson, 2016, 7th Edition.
3. Data and Computer Communications, W. Stallings, Pearson, 2013, 10th Edition.

Course Code-110716 Sensors and Transducers 3 0 0 3

Unit-1.0: Introduction To Sensor- Based Measurement Systems 6 hrs

General Concepts and Terminology, Sensor Classification, General Input-Output Configuration, Static Characteristics of Measurement Systems, Dynamic Characteristics, Primary Sensors, Materials for Sensors.

Unit-2.0: Resistive Sensors 4 hrs

Potentiometer, Strain gauges, Resistance Thermometer, Thermistor.

Unit-3.0: Flow, Pressure and Level Transducers: 11 hrs

Flow Transducers Like Differential Pressure, Variable Area, Positive Displacement, Electromagnetic, Ultrasonic Flow meter, Turbine Flow meter, Electromagnetic Flow meter, Pressure Transducers Like Mercury Pressure Sensor, Bellows, Membranes and Thin Plates, Piezoresistive Sensors, Capacitive Sensors, Optoelectronic Sensors, Level Transducers Like Displacer, Float, Pressure Gages, Balance.

Unit-4.0: Self-Generating Temperature Sensors: 7 hrs

Thermoelectric Sensors: Thermocouples, Piezoelectric Sensors, Pyroelectric Sensors, Electrochemical Sensors, Acoustic Temperature Sensors, Nuclear Thermometer, Magnetic Thermometer, Semiconductor Types, Thermal Radiation, Quartz Crystal, Spectroscopic Noise Thermometry, Heat Flux Sensors.

Unit-5.0: Digital And Semiconductor Sensors: 7 hrs

Position Encoders, Resonant Sensors, Sensors Based on Semiconductor Junctions, Sensors Based on MOSFET Transistors, Charge-Coupled and CMOS Image Sensors, Fiber-Optic Sensors, Ultrasonic-Based Sensors.

Unit-6.0: Sensors For Robotics: 7 hrs

Proximity Sensors: Typical Sensor Characteristics, Technologies for Proximity Sensing, Electro-Optical Sensors, Capacitive Sensors, Magnetic Sensors.

Text/Reference:-

1. D V S Murty “Transducers&Instrumentation” , Prentice-Hall India, 2nd Ed., 2012
2. Patranabis D., "Sensors and Transducers", Prentice-Hall India, 2nd Ed., 2004.

3. Jacob Farden, "Handbook of Modern Sensors: Physics, Designs and Applications", Springer,3rd Ed., 2004.
4. Sawhney A. K., "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai&Sons, 1994.

Course Code-110717 **Cyber Security** **3 0 0 3**

Unit-1.0: Introduction To Security Trends: **8 hrs**

The Computer Security Problem - Targets and Attacks - Approaches to Computer Security Ethics - Basic Security Terminology - Security Models

Unit-2.0: Operational And Organizational Security: **6 hrs**

Policies, Procedures, Standards, and Guidelines

Unit-3.0: The Security Perimeter: **8 hrs**

Physical Security - Environmental Issues - Wireless - Electromagnetic Eavesdropping

Unit-4.0: Cryptography: **8 hrs**

Cryptography in Practice - Historical Perspectives - Algorithms - Hashing Functions - Symmetric Encryption - Asymmetric Encryption

Unit-5.0: Authentication: **6 hrs**

User, Group, and Role Management - Password Policies - Single Sign-On - Security Controls and Permissions - Preventing Data Loss or Theft

Unit-6.0: Intrusion Detection Systems: **6 hrs**

History of Intrusion Detection Systems - IDS Overview - Network-Based IDSs - Host-Based Intrusion Prevention Systems

Text/Reference:-

1. W.A.Coklin, G. White, Principles of Computer Security: Fourth Edition, McGraw-Hill, 2016
2. William Stallings, Cryptography and Network Security Principles and Practices, Seventh Edition, Pearson
3. Achyut S. Godbole, Web Technologies: TCP/IP, Web/Java Programming, and Cloud Computing, Tata McGraw-Hill Education, 2013 E BOOKS

Course Code-110701 **Internship- III** **6 Weeks (6 Credits)**

Internship- III Guidelines

Internship III is of a minimum duration of six weeks which can be completed in an Industry/Institute in consultation with concerned Engineering College/ Institute. After completion of internship a detailed report of the internship mentioning the training undertaken along with certificate should be submitted.

SEMESTER VIII

Course Code-110801	**Project**	**0 0 16 8**

Project Guidelines:

Project should be Analytical/Simulation/Computational/Experimental.

The final evaluation of the project shall include the following.

1. Presentation of the work
2. Oral examination
3. Demonstration of the project
4. Project report submission.

Course Code-110802 **Seminar** **0 0 4 2**

Students shall individually prepare and submit a seminar report on the relevant topic. Each student shall present a seminar on the selected topic. The report and presentation shall be evaluated by a team of experts based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.