1901MA103	MATHEMATICS – I (CALCULUS AND DIFFERENTIAL EQUATIONS)	L	T	P	C
		3	2	0	4

MODULE I **DIFFERENTIAL CALCULUS** **12 Hours**

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature- Evolutes and involutes.

MODULE II **INTEGRAL CALCULUS** **12 Hours**

Double integration – Cartesian and polar coordinates – Change the order of Integration – Applications: Area of a curved surface using double integral – Triple integration in Cartesian co-ordinates – Volume as triple integral.

MODULE III **ORDINARY DIFFERENTIAL EQUATIONS** **12 Hours**

Higher order linear differential equations with constant coefficients – Cauchy's and Legendre's linear equations – Method of variation of parameters in solution of ordinary differential equations

MODULE IV **FOURIER SERIES** **12 Hours**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic analysis.

MODULE V **APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS** **12 Hours**

Variable separable methods-classification-one dimensional wave equation with and without velocity-one dimensional heat equation.

TOTAL: 60 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

REFERENCES:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2018.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

WAVE, OPTICS AND ELECTROMAGNETISM **L T P C**

1901PH102

3 0 0 3

MODULE I **WAVES** **9 Hours**

Mechanical and electrical simple harmonic oscillators- damped harmonic oscillator- forced mechanical and electrical oscillators – impedance - steady state motion of forced damped harmonic oscillator

MODULE II **NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES** **9 Hours**

Transverse wave on a string - The wave equation on a string - Harmonic waves - reflection and transmission of waves at a boundary - impedance matching, standing waves and their Eigen frequencies - longitudinal waves and the wave equation.

MODULE III **WAVE OPTICS** **9 Hours**

Interference of light by wave front splitting and amplitude splitting - Young's double slit experiment - Michelson interferometer - The Rayleigh criterion for limit of resolution and its application to vision - Diffraction gratings and their resolving power.

MODULE IV **ELECTROSTATICS** **9 Hours**

Calculation of electric field and electrostatic potential for a charge distribution - Laplace's and Poisson's equations for electrostatic potential- Practical examples like Faraday's cage and coffee-ring effect Electrostatic field and potential of a dipole - Electric displacement; boundary conditions on displacement - applications in photoconductors - Smoke precipitator and electrostatic air cleaners

MODULE V **MAGNETOSTATICS** **9 Hours**

Bio-Savart law - Divergence and curl of static magnetic field; vector potential and magnetic field using Stokes' theorem - Equation for the vector potential and its solution for given current densities - Solving for magnetic field due to simple magnets like a bar magnet - Magnetic susceptibility and ferromagnetic-paramagnetic and diamagnetic materials - applications: measurement of magnetic flux density - Frequency modulation - DC measurements and Magnetic field measurements in permanent magnets.

TOTAL: 45 HOURS

REFERENCES:

1. I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
3. E. Hecht, "Optics", Pearson Education, 2008.
4. A. Ghatak, "Optics", McGraw Hill Education, 2012.
5. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
6. David Griffiths, Introduction to Electrodynamics
7. Halliday and Resnick, Physics
8. W. Saslow, Electricity, magnetism and light

1901GE101	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

MODULE I **DC CIRCUITS** **6 Hours**

Ohm's law and Kirchhoff's laws - Mesh Analysis - Node Analysis - Network reduction - Voltage and current division - Source transformation - Star-delta conversion.

MODULE II **AC CIRCUITS** **7 Hours**

RMS, average, form factor and peak factor for basic waveforms - Steady state analysis of RL, RC and RLC circuits; power and power factor - Solving AC circuits using mesh and node analysis - Three phase circuits.

MODULE III **NETWORK THEOREMS** **7 Hours**

Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem and Maximum power transfer theorem; applications of network theorems.

MODULE IV **RESONANT CIRCUITS** **7 Hours**

Series, parallel, series-parallel circuits; effect of variation of Q on resonance; Relations between circuit parameters - Quality factor, resonant frequency and bandwidth.

MODULE V **COUPLED CIRCUITS** **7 Hours**

Self and mutual inductances, coefficient of coupling, dot convention; analysis of simple coupled circuits, inductively coupled circuits; single tuned and double tuned circuits.

MODULE VI **TRANSIENT ANALYSIS** **7 Hours**

Transient response of RL, RC and RLC circuits to DC and AC excitation; Natural and forced oscillations; Laplace transform application to transient solution.

MODULE VII **TWO PORT NETWORKS** **4 Hours**

Z, Y, H and ABCD parameters.

TOTAL: 45 HOURS

REFERENCES:

1. A.Sudhakar and S.P. Shyammohan, "Circuits and Networks: Analysis and Synthesis", TMH, 4th Edition, 2010.
2. M.Nahvi and Joseph A.Edminister, "Electric Circuits", Schaum's Outline series, Tata McGrawHill, New Delhi, 6th Edition, 2014.
3. James W. Nilsson and Susan Riedel, "Electric Circuits", Pearson, 10th Global Edition, 2014.
4. William H. Haytand Jack Kemmerly, "Engineering circuit analysis", Tata McGrawHill, 8th Edition, 2013.
5. Charles. K.Alexander and Mathew N.O.Sadiku, "Fundamental of Electric Circuits", TMH, 5thEdition, New Delhi, 2013.
6. S.N. Sivanandam, "Electric Circuit Analysis", Vikas Publishing House Pvt. Ltd., New Delhi, 2nd Edition, 2008.
7. T.S.K.V IYER, "Theory and Problems in Circuit Analysis", Tata McGrawHill, 2nd edition, 2010.
8. A.Chakrabarti, "Circuits Theory: Analysis and Synthesis", Dhanpat Rai& Co., 2014 Edition.

1901GEX02	ENGINEERING GRAPHICS	L	T	P	C
	(Common for all B.E./B.Tech. Programme)	**2**	**0**	**2**	**3**

MODULE I CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

MODULE II PLANE CURVES AND FREE HAND SKETCHING **9 Hours**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of Objects.

MODULE III PROJECTION OF POINTS, LINES AND PLANE SURFACES **9 Hours**

Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

MODULE IV PROJECTION OF SOLIDS **9 Hours**

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

MODULE V PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **9 Hours**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

MODULE VI ISOMETRIC AND PERSPECTIVE PROJECTIONS **9 Hours**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

TOTAL: 45 HOURS

REFERENCES:

1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore,2016.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2015.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2017.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2015.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2016.

1901GEX51	CAD (COMPUTER AIDED DRAFTING) LAB (Common for all B.E./B.Tech. Programme)	L 0	T 0	P 2	C 1

List of Experiments:

Basics commands of a CAD software- two-dimensional drawing, editing, layering and dimensioning - coordinate Systems-Drawing practice - orthographic views of simple solids using CAD software.

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B-spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
7. Drawing isometric projection of simple objects.
8. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Total: 30 Hours

References:

1. N.D. Bhatt, Machine Drawing, Charotar Publishing House Pvt. Ltd., 2014.
2. P.S. Gill, A Textbook of Machine Drawing, Katson books, 2013.
3. R.K. Dhawan, A Textbook of Machine Drawing, S. Chand,2012.
4. K.C. John, Textbook of Machine Drawing, PHI Learning Pvt. Ltd.,2009.

1901GEX53	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY (Common for all B.E./B.Tech. Programme)	L	T	P	C
		0	0	2	1

List of Experiments:

1. Experiments related to verification of Ohm's law and Kirchhoff's laws
2. Experiments involving logic gates
3. Fan and light control using regulators
4. Design of 6V regulated power supply
5. Energy conservation demonstration experiment using energy meter
6. Waveform generation and calculation of rms and average values
7. IC 555 and IC 741 based experiments
8. Experiments in earthing
9. Staircase wiring and residential building wiring
10. Speed control of DC shunt motor

Total: 30 Hours

References:

1. Edward Hughes, " Electrical Technology,", Pearson Education
2. D.P. Kothari and Nagrath " Basic Electronics",MH Education 2013.
3. Paul Scherz and Simon Monk "Practical Electronics for inventors" Mc Graw Hill Publications 2013.

1901PHX51	ENGINEERING PHYSICS LAB (Common for all B.E./B.Tech. Programme)	L	T	P	C
		0	0	2	1

List of Experiments:

1. Determination of wavelength of various colours of mercury spectrum using Laser grating
2. Determination of velocity of liquids using ultrasonic interferometer
3. Determine the dispersive power of a prism using spectrometer
4. Determine the unknown resistance of the given wire using Carey-Foster's Bridge
5. Determine the band gap of the given semiconductor
6. Determine the acceptance angle and particle size using Laser
7. Torsional pendulum – Rigidity modulus of a steel wire
8. Thickness of a thin wire – Air Wedge
9. Measurement of Young's modulus – Uniform and Non-uniform bending
10. Thermal conductivity –Lee's Disc method

Total: 30 Hours

References:

1. 'Practical Physics', R.K. Shukla, Anchal Srivastava, New age international (2011)
2. 'B.Sc. Practical Physics', C.L Arora, S. Chand &Co. (2012)

1901GE151	Engineering Intelligence-I	L	T	P	C
	(Common for all B.E./B.Tech. Programme)	0	0	2	1

List of Experiments:

1. **Activities on Fundamentals of Inter-personal Communication**

Starting a conversation - responding appropriately and relevantly - using the right body language - Role Play in different situations & Discourse Skills- using visuals.

2. **Activities on Reading Comprehension**

General Vs Local comprehension, reading for facts, guessing meanings from context, Scanning, skimming, and inferring meaning, critical reading & effective googling.

3. **Activities on Writing Skills**

Structure and presentation of different types of writing - letter writing/ Resume writing/e-correspondence/ Proposal writing/Technical report writing/ Portfolio writing - planning for writing - improving one's writing.

4. **Activities on Presentation Skills**

Oral presentations (individual and group) through JAM sessions / seminars / PPTs and written presentations through posters/ projects/ reports/ e-mails/ assignments etc.- creative and critical thinking.

5. **Activities on Soft Skills**

Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews-Time management-stress management –paralinguistic features- Multiple intelligences – emotional intelligence – spiritual quotient (ethics) – intercultural communication – creative and critical.

Total: 30 Hours

References:

1. Raman, Meenakshi and Sangeetha Sharma, “Technical Communication: Principles and Practice”, Oxford University Press, New Delhi, 2011.
2. Sudha Rani, D , “Advanced Communication Skills Laboratory Manual” , Pearson Education 2011.
3. Paul V. Anderson ,“Technical Communication”,. Cengage Learning pvt. Ltd. New Delhi, 2007.
4. “English Vocabulary in Use series”, Cambridge University Press 2008.
5. “Management Shapers Series” ,Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Rizvi and Ashraf M., “Effective Technical Communication”, Tata McGrawHill, New Delhi, 2005.
7. Jones, D, “The Pronunciation of English”, CUP, . Cambridge,2002.

1901MA203	ENGINEERING MATHEMATICS – II (Linear Algebra, Transform Calculus and Numerical Methods)	L	T	P	C
		3	2	0	4

MODULE I **MATRICES** **12 Hours**

Characteristic equation - Eigen values and Eigen vectors of a real matrix – Properties - Cayley– Hamilton theorem- Diagonalization of Matrices - Reduction of a quadratic form to a canonical form by orthogonal transformation – Application of Matrices in Structural Engineering and image processing

MODULE II **TRANSFORM CALCULUS** **12 Hours**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

MODULE III **SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** **12 Hours**

Solution of algebraic and transcendental equations – Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formulae. Numerical Differentiation (first two derivatives) Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 thrules (single integral)

MODULE IV **NUMERICAL METHODS OF ORDINARY DIFFERENTIAL EQUATIONS** **12 Hours**

Taylor's series, Euler and modified Euler's methods.RungeKutta method of fourth order for solving first order equations.Milne's and Adam's predicator-corrector methods.

MODULE V **NUMERICAL METHODS OF PARTIAL DIFFERENTIAL EQUATIONS** **12 Hours**

Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

TOTAL: 60 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

REFERENCES:

1. D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.
3. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

1901CH202	APPLIED CHEMISTRY	L	T	P	C
		3	0	0	3

MODULE I ELECTROCHEMISTRY **9 Hours**

Electrochemistry -Cell terminology-Electrochemical cells- Electrolytic cells- Cell reactions- Daniel cell- Difference between electrolytic cells and electrochemical cells. Reversible cells and irreversible cells - types- EMF and its applications - Nernst equation (derivation and problems).Single electrode potential - Hydrogen electrode - Calomel electrode - Glass electrode - pH measurement using glass electrode.

MODULE II POLARISATION AND OVER POTENTIAL **9 Hours**

Polarisation and Over Potential- Electrolytic polarization, Dissolution and Decomposition potential, Overvoltage – hydrogen and oxygen overvoltage, applications, Polarography – principles, diffusion layer, limiting current density, polarographic circuit, dropping mercury electrode, merits & demerits, supporting electrolyte, current maxima, polarograms, half wave potential, diffusion current, applications

MODULE III CONVENTIONAL ENERGY RESOURCES AND NON CONVENTIONAL ENERGY RESOURCES **9 Hours**

Conventional Energy Resources and Non Conventional Energy Resources- Conventional- Petroleum Oil, Coal, Natural Gas, Non Conventional -Introduction- nuclear energy- nuclear fission, nuclear fusion- nuclear chain reactions- breeder reactor- Nuclear Reactor-solar energy conversion- solar cells- wind energy.

MODULE IV STORAGE DEVICES **9 Hours**

Storage Devices- Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery nickel-cadmium battery- lithium battery- fuel cell H2 -O2 fuel cell- applications.

MODULE V POWER PLANTS AND TRANSMISSION MATERIALS **9 Hours**

Power Plants and Transmission Materials- power plant- types- hydroelectric power plants thermal power plants, solar power plants, wind *power plant*, geo thermal power generation and tidal power generation, transmission materials- conducting material- low resistivity or high conductivity- high resistivity or low conductivity conducting material- materials for lamp filaments, transmission line, electrical carbon and Fuse, Transformer oil, insulators.

TOTAL: 45 HOURS

REFERENCES:

1. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2010.
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company, Ltd., New delhi 2010
3. Gowariker V.R., Viswanathan N.V. and Jayadev Sreedhar, “Polymer Science”, New Age
4. Kannan P. and Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009
5. J.O.M.Bockris & A.K.N.Reddy, “Modern Electrochemistry –Vol. I & II” , Plenum Press, New York, 2000.
6. Peter Atkins and Julio de Paula, “Physical Chemistry”, VII Edition, Oxford University Press, New York, 2002.
7. A.J. Bard and L.R. Faulkner, “Electrochemical Methods – Fundamentals and applications” 3 rd edition John Wiley & Sons Inc, 2001.
8. https://mnre.gov.in/file-manager/UserFiles/pdf/Trainers%20Textbook_SHP.pdf
9. onlinelibrary.wiley.com/doi/10.1002/9780470661345.smc107/pdf
10. https://www.electrical4u.com/classification-of-electrical-conducting-material/

1901GEX03	PROGRAMMING FOR PROBLEM SOLVING	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO PROGRAMMING **9 Hours**

Components of Computers and its Classifications- Generations of Computers- Number System- Problem Solving Techniques – Algorithm Design– Flowchart–Pseudocode-Algorithm to program, Compilation and Execution.

MODULE II BASICS OF C PROGRAMMING **9 Hours**

Structure of C program - C programming: Data Types – Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives

MODULE III ARRAYS AND STRINGS **9 Hours**

Introduction to Arrays: Declaration, Initialization – One dimensional array – Example Program: Computing Mean, Median and Mode - Two dimensional arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

MODULE IV FUNCTIONS AND POINTERS **9 Hours**

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion – Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example Program: Swapping of two numbers and changing the value of a variable using pass by reference

MODULE V STRUCTURES & FILE PROCESSING **9 Hours**

Structure - Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Dynamic memory allocation - Singly linked list -Files – Types of file processing: Sequential access, Random access – Sequential access file - Example Program: Finding average of numbers stored in sequential access file - Random access file - Example Program: Transaction processing using random access files – Command line arguments.

TOTAL: 45 Hours

REFERENCES:

1. Paul Deitel and Harvey Deitel, ―C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, ―Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, ―Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, ―Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

1901ENX01	ENGLISH FOR ENGINEERS	L	T	P	C
		2	0	0	2

MODULE I **FOCUS ON LANGUAGE (Vocabulary and Grammar)** **6 Hours**

Vocabulary -The Concept of Word Formation - prefixes- suffixes- Synonyms - Antonyms. Grammar -Articles- Preposition- Adjective-Adverb-connectives -Tenses (present, past & future)-Impersonal passive voice - Wh-Questions

MODULE II **LISTENING SKILLS** **6 Hours**

Listening- listening intently-arousing and sustaining interest-listening to short or longer texts- formal and informal conversations- telephonic etiquettes- narratives from different sources.-listening and Note taking-correlative verbal and non verbal communication-listening to TOEFL & IELTS programs .

MODULE III **SPEAKING SKILLS** **6 Hours**

Speaking - stress and intonation –persuasive speaking -Describing person, place and thing - sharing personal information — greetings –taking leave -Individual and Group Presentation-impromptu presentation-public speaking-Group Discussion.

MODULE IV **READING SKILLS** **6 Hours**

Reading– comprehending general and technical articles -cloze reading - inductive reading- short narratives and descriptions from newspapers – Skimming and scanning-reading and interpretation-critical reading-interpreting and transferring graphical information- sequencing of sentences.

MODULE V **WRITING SKILLS** **6 Hours**

Writing- Precise writing –Summarizing- interpreting visual texts (pie chart, bar chart, picture, advertisements etc., -Proposal writing -report writing-job application-e-mail drafting- letter writing(permission, accepting and decaling)-instructions –recommendations –checklist.

TOTAL: 30 Hours

REFERENCES:

1. Raman, Meenakshi and Sangeetha Sharma. (2011). Technical Communication: Principles and Practice. New Delhi: Oxford University Press.
2. Rizvi and Ashraf M. (2005). Effective Technical Communication. New Delhi: Tata McGraw-Hill.
3. G. Radhakrishna Pillai. English for Success- Central Institute of English and Foreign Languages, Hyderabad: Emerald Publishers.
4. Jones, D. (2002).The Pronunciation of English. Cambridge: CUP; rpt in facsimile in Jones.
5. English for Engineers - Regional Institute of English (2006) .New Delhi: Cambridge University Press.
6. Rutherford and Andrea. (2001). Basic Communication Skills for Technology. New Delhi: Pearson.
7. Viswamohan A. (2008). English for Technical Communication. New Delhi: Tata McGraw-Hill.

1901GE201	ENGINEERING EXPLORATION	L	T	P	C
		2	0	0	2

What is Engineering: Engineering Requirement, Knowledge within Engineering disciplines, Engineering advancements.

Engineering Design: Problem definition, idea generation through brainstorming and researching, solution creation through evaluating and communicating, text/analysis, final solution and design improvement.

Defining problems and Brainstorming: Researching design, sketching problem solving.

Communicating solution: Dimensioning orthographic drawing, perspective drawing.

Modeling and Testing final output: Product evaluation, reverse engineering, final project report.

Civil Engineering: Structural forces structural analysis, bridge design components, structural design.

Mechanical Engineering: Types of motion, mechanical power system, mechanical power formula, mechanical design.

Electrical Engineering: Reading analog multimeter, measuring current, voltage and resistance, electricity from chemicals, solar cells, magnets, Ohms law and watts law, circuit identification and circuit calculation, resistor color code, continuity.

Computer Engineering: Logic gates, algorithms, computer architecture, binary code.

TOTAL: 30 Hours

REFERENCES:

1. Ryan A.Brown, Joshua W.Brown and Michael Berkihiser: “Engineering Fundamentals: Design, Principles, and Careers”, Goodheart-Willcox Publisher, Second Edition, 2014.

2. Saeed Moaveni ,“Engineering Fundamentals: An Introduction to Engineering”, Cengage learning, Fourth Edition, 2011.

1901CHX51	ENGINEERING CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

List of Experiments

1. Determination of total, temporary & permanent hardness of water by EDTA method
2. Determination of strength of given hydrochloric acid using pH meter
3. Estimation of iron content of the given solution using potentiometer
4. Estimation of sodium present in water using flame photometer
5. Corrosion experiment – weight loss method
6. Determination of molecular weight of a polymer by viscometer method
7. Conductometric titration of strong acid Vs strong Base
8. Estimation of dissolved oxygen in a water sample/sewage by Winkler's method.
9. Comparison of alkalinities of the given water samples
10. Determination of concentration of unknown colored solution using spectrophotometer
11. Determination of percentage of copper in alloy
12. Determination of ferrous iron in cement by spectrophotometry method
13. Adsorption of acetic acid on charcoal
14. Determination the flash point and fire point of a given oil using pen skyMartine closed cup apparatus
15. Determination the calorific value of solid fuels
16. Determination the structural of the compound using chemo software.

Total: 30 Hours

References:

5. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel"s Textbook of practical organic chemistry", LBS Singapore (1994).
6. Jeffery G.H., Bassett J., Mendham J.and Denny vogel"s R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
7. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New Yor (2001).
8. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

1901GE253	BASIC WORKSHOP LABORATORY	L	T	P	C
		0	0	2	1

List of Experiments

1. Forming of simple object in sheet metal using suitable tools (Example: Dust Pan, Soap Box, Aluminum Cup, etc).
2. Prepare V (or) Half round (or) Square (or) Dovetail joint from the given mild Steel flat.
3. Prepare simple components using arc and gas weldings
4. Making a simple component using carpentry power tools. (Example: Electrical switch Box/Tool box/ Letter box.
5. Construct a household pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend, Gate way and Taps (or) Construct a pipe connections of house application centrifugal pump using pipes, bend, gate valve, flanges and foot valve.
6. Rapid Prototyping

REFERENCES: Lab manual

TOTAL: 30 Hours

1901GEX52	COMPUTER PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

List of Experiments

1. Working with word and style sheets
2. Write a C program to implement basic concepts
3. Write a C program to implement Decision Making and Branching statements
4. Write a C program to implement looping statements
5. Write a C program to implement Arrays
6. Write a C program to implement Strings
7. Write a C program to implement pointers
8. Write a C program to implement Structures
9. Write a C program to work with files in C

Total: 30 Hours

References:

1. Paul Deitel and Harvey Deitel, ―C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, ―Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011
3. Pradip Dey, Manas Ghosh, ―Fundamentals of Computing and Programming in C‖, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, ―Computer Fundamentals and Programming in C‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

1901HSX51	COMMUNICATION SKILL LABORATORY	L	T	P	C
		0	0	2	1

List of Experiments:

1. **Activities on Fundamentals of Inter-personal Communication**

Starting a conversation - responding appropriately and relevantly - using the right body language - Role Play in different situations & Discourse Skills- using visuals.

2. Activities on Reading Comprehension

General Vs Local comprehension, reading for facts, guessing meanings from context, Scanning, skimming, and inferring meaning, critical reading & effective googling.

3. Activities on Writing Skills

Structure and presentation of different types of writing - letter writing/ Resume writing/e-correspondence/ Proposal writing/Technical report writing/ Portfolio writing - planning for writing - improving one's writing.

4. Activities on Presentation Skills

Oral presentations (individual and group) through JAM sessions / seminars / PPTs and written presentations through posters/ projects/ reports/ e-mails/ assignments etc.- creative and critical thinking.

5. Activities on Soft Skills

Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation-Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conferencing and Mock Interviews-Timemanagement-stress management –paralinguistic features- Multiple intelligences – emotionalintelligence – spiritual quotient (ethics) – intercultural communication – creative and critical.

Total: 30 Hours

References:

1. Raman, Meenakshi and Sangeetha Sharma, “Technical Communication: Principles and Practice”, Oxford University Press, New Delhi, 2011.
2. Sudha Rani, D , “Advanced Communication Skills Laboratory Manual” , Pearson Education 2011.
3. Paul V. Anderson ,“Technical Communication”,. Cengage Learning pvt. Ltd. New Delhi, 2007.
4. “English Vocabulary in Use series”, Cambridge University Press 2008.
5. “Management Shapers Series” ,Universities Press (India) Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Rizvi and Ashraf M., “Effective Technical Communication”, Tata McGrawHill, New Delhi, 2005.
7. Jones, D, “The Pronunciation of English”, CUP, . Cambridge,2002.

1901GE252	ENGINEERING INTELLIGENCE II	L	T	P	C
		0	0	2	1

MODULE I **VOCABULARY BULIDING** **6 hours**

Parts of Grammar- SVA- Art of Writing- word building activities

MODULE II **COMMUNICATION WORKSHOP** **6 Hours**

Story Telling- Newspaper Reading-Extempore

MODULE III **INTERPERSONAL SKILLS** **6 Hours**

Personality Development - Creativity and innovation –Critical Thinking and Problem Solving – Work Ethics-Technical Skill Vs Interpersonal Skills

MODULE IV **LEADERSHIP& EMPLOYABILITY SKILLS** **6 Hours**

Levels of Leadership-Making of a leader-Type of leadership-Transactions Vs Transformational Leadership –Exercises - Industry Expectations & Career Opportunities- Recruitment patterns.

MODULE V **RESUME BUILDING** **6 Hours**

Importance of Resume- Resume Preparation - introducing onself

TOTAL: 30 Hours

REFERENCES:

1. Barun K. Mitra; (2011), *"Personality Development & Soft Skills*", First Edition; Oxford Publishers.
2. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition , 2007
3. Arun Sharma and Meenakshi Upadhyav, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition 2017

1901MA303	Engineering Mathematics III (Complex Variables, Vector Calculus and Transforms)	L	T	P	C
		3	2	0	4

MODULE I **ANALYTIC FUNCTIONS** **12 Hours**

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w = z+k, kz, 1/z, , and bilinear transformation.

MODULE II **VECTOR CALCULUS** **12 Hours**

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration: Greens theorem in a plane, Gauss divergence theorem and Stokes‟ theorem (excluding proofs) – Applications of the above theorems to find surface area of a closed region and volume of cube and parallel piped.

MODULE III **COMPLEX INTEGRATION** **12 Hours**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

MODULE IV **FOURIER TRANSFORMS** **12 Hours**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval‟s identity

MODULE V **TRANSFORMS** **12 Hours**

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform

TOTAL: 60 HOURS

REFERENCES:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,(2011).
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).
3. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., (2011)
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, (2012).
5. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, (2012).
6. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2008).

1902EE301	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

MODULE I **DIODES** **9 Hours**

PN Junction Diode: Structure, Operation and V-I characteristics; Capacitance effect – Diffusion capacitance and transition capacitance; Diode model; Applications–Clippers and clampers.

Zener Diode: V-I Characteristics, Breakdown mechanism; Application – Voltage regulator.

Special Function Diodes: Structure and operation of LED, Laser diode, Tunnel diode, Schottky diode and Photodiode.

MODULE II **BIPOLAR JUNCTION TRANSISTOR AND CIRCUITS** **9 Hours**

BJT: Structure, operation, biasing circuits, V-I characteristics in common base, common emitter and common collector configurations; DC and AC load line analysis- Determination of Q point; Secondary breakdown; Small signal model;Analysis and comparison of CB, CE and CC amplifiers; Low and high frequency response of an amplifier; Darlington amplifier.

MODULE III **FIELD EFFECT TRANSISTOR CIRCUITS** **9 Hours**

JFET: Structure, operation, n channel and p channel, V-I characteristics and biasing circuits of JFET.

MOSFET: Structure and operation of D-MOSFET & E-MOSFET, V-I characteristics, Biasing circuits, small signal model; Analysis of common source and common drain amplifiers; high frequency equivalent circuit; Comparison of devices.

MODULE IV **DIFFERENTIAL AND POWER AMPLIFIERS** **9 Hours**

Differential Amplifier: Common mode and difference mode analysis of BJT based differential amplifier.

Single Tuned Amplifiers: Gain and frequency response of single tuned BJT and FET amplifiers; Neutralization methods.

Power Amplifiers: Class A, class B, class C and class AB Amplifiers (Qualitative analysis).

MODULE V **FEEDBACK AMPLIFIERS AND OSCILLATORS** **9 Hours**

Negative Feedback: Voltage series, current series, current shunt and voltage shunt amplifiers – Input impedance, output impedance, current gain, voltage gain, overall current gain and overall voltage gain.

Positive Feedback: Barkhausen criterion; RC oscillators – RC phase shift and Wien bridge oscillators; LC oscillators – Hartley, Colpitts and Clapp; Crystal oscillators – Miller and Pierce crystal oscillators.

TOTAL: 45 HOURS

REFERENCES:

1. Milman, Halkias and Satyabrata Jit, Electronic Devices and Circuits, McGraw Hill Education (India) Private Ltd., 4th Edition, 2015.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, PHI Ltd., 11th Edition, 2015.
3. David A. Bell, Electronic Devices and Circuits‖, Oxford University Press, 5tn Edition, 2008.
4. Thomas L. Floyd, Electronic Devices, An Imprint of Mc Millan publishing company, 10th Edition, 2017.
5. Prof.A.N.Chandorkar, IIT Bombay online lecture series onAnalog Electronics http://nptel.ac.in/courses/117101106/
6. Albert Malvino and David Bates, Electronic Principles, 8th Edition,
7. Prof.S.Karmalkar,IITMadras, online lecture series on Solid State Devices http://nptel.ac.in/courses/117106091/
8. https://onlinecourses.nptel.ac.in/noc18_ee32/preview.

1902EE302	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

MODULE I **NUMBER SYSTEM AND BOOLEAN ALGEBRA** **9 Hours**

Review of number system, Binary codes –BCD, Gray code, Excess 3 code; Error detection and correction codes – Parity, Hamming codes.

Boolean postulates- laws, rules & theorems; Standard forms of Boolean expressions, conversions; Simplification using K-maps-3, 4 and 5 variables.

MODULE II **COMBINATIONAL LOGIC CIRCUITS** **9 Hours**

Design of adders, subtractors, comparators, code converters, encoders, decoders, multiplexers and de-multiplexers. Function realization using multiplexers; Booth multiplier and Array Multiplier; Simulation of simple logic circuits.

MODULE III **SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS** **9 Hours**

Latches-operation of SR and gated SR latch; Flip flops – Method of edge triggering, SR, JK, Master Slave JK, D, and T flip flops; Important signals of FF.

Design of Synchronous sequential circuits- Model Selection, State transition diagram, State synthesis table, Design equations, State reduction technique and Implementation; Binary counters-4 bit UP, DOWN and UP/DOWN counters; BCD counters, Ring counters, shift registers, Johnson counters.

MODULE IV **ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS** **9 Hours**

Synchronous Vs Asynchronous sequential circuits; Design of asynchronous sequential circuits-Design steps, State transition diagram, State table, FF transition table, K-map based Primitive table, State reduction techniques, state assignment and design equations; Races and hazards.

MODULE V **MEMORY DEVICES, PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES** **9 Hours**

Memories: ROM, PROM, EPROM; Programmable Logic Devices – PLA, PAL, PLD. Logic families: TTL, ECL, CMOS; Case study on four bit accumulator.

TOTAL: 45 HOURS

REFERENCES:

1. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 4th edition, 2013.
2. A.Anandkumar, “Fundamentals of digital circuits”, 3rd Edition, PHI Learnings Pvt. Ltd, 2014.
3. Malvino and Leach, Digital Principles and Applications, Tata McGraw Hill, New Delhi, 7th edition, 2011.
4. Floyd, Digital Fundamentals, Pearson Education, 10th edition, 2011.
5. John F.Wakerly, Digital Design Principles and Practice, Pearson Education, 4th edition, 2008.
6. http://nptel.ac.in/courses/117106086/

1902EE303	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	2	0	4

MODULE I **DC GENERATOR** **12 Hours**

Rekindling of magnetic circuit fundamentals; DC generator- Construction, Materials for different parts, development of lap and wave winding, EMF equation, excitation types, Commutation, Armature reaction, Compensating winding, and characteristics;Simulation study on dc separately excited dc generator.

MODULE II **DC MOTOR** **12 Hours**

Principle of operation, Classification, Torque equation, Characteristics, Starters; Speed Control and Braking methods; Simulation of dc motors.

MODULE III **TESTINGAND APPLICATIONS OF DC MACHINES** **12 Hours**

Losses and Efficiency calculations; Testing- Swinburne‘s test, Brake test, Hopkinson test; Industrial applications of DC generators& DC motors; Energy saving options.

MODULE IV **TRANSFORMER** **12 Hours**

Single phase transformer: Construction, Principle of operation, Classification, Ideal transformer, Equivalent circuit, Phasor diagrams, Voltage regulation, Characteristic curves, Conditions for maximum regulation and power factor; Parallel operation of transformers.

Three phase transformer: Parts of transformer, Cooling, Connections, Tertiary winding; Inrush current; Per unit representation.

MODULE V **PERFORMANCE EVALUATION AND APPLICATIONS OF TRANSFORMER** **12 Hours**

Performance evaluation of transformer: Open circuit and Short circuit test, Polarity test, Load test, Sumpner‘s test;Design over view of transformer.

Applications of transformer: Auto transformer, Power transformer, Distribution transformer-Calculation of All day efficiency, Potential transformer, Current transformer and Isolation transformers.

TOTAL: **60 HOURS**

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, 2010.
2. Edward Hughes, Electrical and Electronic Technology, 12th edition, Pearson, 2016.
3. P. S. Bimbhra, Electrical Machinery, Khanna Publishers, 7th edition, 2011.
4. B. L. Theraja and A. K. Theraja, ―Text Book of Electrical Technology: AC & DC Machines (Volume- 2), S.Chand& Company Ltd., New Delhi, 2008.
5. M.N.Bandyopadhyay, Electrical Machines Theory and practice, PHI Learning Pvt. Ltd, New Delhi 2007.
6. Electrical Machines-I Nptel lecture video by Dr. D.Kastha, IIT Kharagpur.

1902CS307	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		3	0	0	3

MODULE I **INTRODUCTION TO C++** **9 Hours**

Introduction to C++ – classes – access specifiers – function and data members – default arguments – function overloading – friend functions – const and volatile functions – static members – Objects – pointers and objects – constant objects – nested classes – local classes

MODULE II **CONSTRUCTORS** **9 Hours**

Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor – destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion – explicit constructor

MODULE III **INTRODUCTION TO JAVA** **9 Hours**

Overview of java-data types-variables-operators-arrays-control statements-object and classes- methods-access specifiers-static members-finalize methods-constructors-exception handling

MODULE IV **INHERITANCE AND POLYMORPHISM** **9 Hours**

Inheritance-super keyword-types of inheritance – polymorphism- method overriding-method overloading-abstract class-inner class-interfaces-reflections

MODULE V **PYTHON PROGRAMMING** **9 Hours**

Data types – variables – operators – control flow – class/objects – Inheritance – functions

TOTAL: 45 HOURS

REFERENCES:

1. B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2018.
2.H.M.Deitel, P.J.Deitel, “Java how to program”, Fifth edition, Prentice Hall of India private limited,2017.
3. Ira Pohl, “Object-Oriented Programming Using C++”, Pearson Education Asia, 2017.
4.K.R.Venugopal, RajkumarBuyya, T.Ravishankar, “Mastering C++”, TMH, 2015.

5. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
6. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2018

1902EE351	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode and Zener diode.
2. Design of Clipper and Clamper circuits.
3. Characteristics of CE and CB configurations.
4. Characteristics of JFET / MOSFET.
5. Design and verify the frequency response of single stage transistor amplifier.
6. Design and verify the frequency response of RC phase shift oscillator.
7. Frequency response of two stage RC coupled amplifier.
8. Verify the V-I characteristics of photo diode and photo transistor.
9. Design and test a voltage regulator circuit using zener diode.
10. Design a transistor based battery charging control circuit.
11. Design of Hartley Oscillator
12. Design of Colpitts Oscillator

TOTAL: 30 HOURS

ADDITIONAL EXPERIMENTS:

1. Design of transistor based differential amplifier.
2. Real time applications using logic gates/Flip-flops.

REFERENCES:

1. Mr.K. Krishnaram, ―Electronic Devices and Circuits – Lab Manual‖ 2018.
2. Milman, Halkias and Satyabrata Jit, ―Electronic Devices and Circuits‖ 4th Edition, Mc Graw Hill Education (India) Private Ltd, 2015.
3. Integrated circuits: Solution manual: Analog digital circuits and systems manual by Jacob Millman.

1902EE352	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Swinburne‘s test and load test on DC shunt motor.
2. Parallel operation of single phase transformers.
3. Load test on DC series motor.
4. Load test on DC compound motor.
5. Speed control of DC shunt motor (Field control & armature control method).
6. Open circuit and load characteristics of DC shunt generator.
7. Open circuit and short circuit test on single phase transformer.
8. Open circuit and short circuit test on three phase transformer.
9. Load test on single phase transformer.
10. Load test on three phase transformer.

TOTAL : 30 HOURS

ADDITIONAL EXPERIMENTS :

1. Sumpner‘s test on single phase transformer.

REFERENCES:

1. B.A.NaveenAntony―ElectricalMachinerylaboratory-1Manual,2018.
2. D.P.Kothari & B.S.Umre, Laboratory Manual for Electrical Machines, I.K.International publishing house Pvt. Ltd., 2013.
3. B.L.Theraja &.K.Theraja, Text BookofElectricalTechnology: AC&DCMachines–Volume-2, S.Chand & Company Ltd., NewDelhi, 2008.

1902CS355	OBJECT ORIENTED PROGRAMMING LAB	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Write a C++ program using Static Data Members
2. Write a C++ program to implement the Multiple constructor in a class
3. Write a C++ program to implement Operator overloading for Unary and binary operator
4. Write a C++ program to implement Constructor in derived classes
5. Write a Java program to implement Control Statements
6. Write a Java program to implement Multi-threaded programming
7. Write a Java program to implement Multiple Inheritance
8. Write a Java program to implement Polymorphism
9. Write a program to implement control flow in Python
10. Write a python programs using functions.

Total: 30 Hours

ADDITIONAL EXPERIMENTS:

1. Program to overload unary and binary operator as Nonmember function.
2. Write a Java program to develop simple application(project) using OOP's concept.

REFERENCES:

1. https://lecturenotes.in/practicals/19363-lab-manuals-for-object-oriented-programming
2. http://studentsfocus.com/cs6461-object-oriented-programming-lab-manual
3. http://bietbvrm.ac.in/public/testimonia
4. http://www.srmuniv.ac.in/sites/default/files
5. https://rcetcsevani.files.wordpress.com/2017/11/ppp-lab-manual.pdf

1904GE351	LIFE SKILLS: SOFT SKILLS	L	T	P	C
		0	0	2	1

MODULE I **INTRODUCTION TO SOFT SKILLS** **6 Hours**

Soft Skills an Overview - Basics of Communication – Body Language – Positive attitude –Improving Perception and forming values – Communicating with others.

MODULE II **TEAM VS TRUST** **6 Hours**

Interpersonal skills – Understanding others – Art of Listening - Group Dynamics –Essential of an effective team - Individual and group presentations - Group interactions – Improved work Relationship .

MODULE III **SELLING ONESELF** **6 Hours**

How to brand oneself – social media – job hunting – Resume writing – Group Discussion – Mock G.D - .Interview skills – Mock Interview

MODULE IV **CORPORATE ETIQUETTE** **6 Hours**

What is Etiquette – Key Factors – Greetings – Meeting etiquette – Telephone etiquette – email etiquette – Dining etiquette – Dressing etiquette .

MODULE V **LEARNING BY PRACTICE** **6 Hours**

My family-Myself-Meeting people-Making Contacts.-A city-Getting about town-Our flat-Home life-Travelling - Going abroad- Going through Customs-At a hotel-Shopping- Eating out- Making a phone call- A modern office-Discussing business.

TOTAL: **30 HOURS**

REFERENCES:

1 Dr.k.Alex, “soft skills “Third Edition, S.Chand & Publishing Pvt Limited, 2009
2. Aruna koneru, ‘Professional Communication’ Second Edition, Tata McGraw-Hill Education, 2008
3. D.K.Sarma,’You & Your Career ‘First Edition Wheeler Publishing & Co Ltd, 1999
4. Shiv Khera ‘You Can Win’ Third Edition Mac Millan Publisher India Pvt Limited, 2005

1902EE401	GENERATION, TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	2	0	4

MODULE I **ELECTRICAL POWER GENERATION** **12 Hours**

(Block diagram/Qualitative approach only)

Structure of electric power system: Single line diagram, different operating voltages of generation, transmission and distribution.

Types of energy and classification of power plants; Present power position in India, Future planning for power generation.

Power generation from Non-Renewable energy sources: Thermal and Nuclear based power generation

Power generation from Renewable energy sources: Solar, Wind, Hydro, Tidal, Geothermal, Fuel cell and Bio-mass based power generation.

MODULE II **MECHANICAL DESIGN OF LINES, AND INSULATORS** **12 Hours**

Mechanical design of OH lines: Line supports, Types of towers, Stress and Sag calculation, Towers at equal heights , Unequal heights, Effects of wind and ice loading, stringing chart.

Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

MODULE III **PARAMETERS OF TRANSMISSION LINES, AND UNDERGROUND CABLES** **12 Hours**

Parameters of single and three phase transmission lines: Resistance, inductance and capacitance of symmetrical and unsymmetrical transposed solid, stranded and bundled conductors; self and mutual GMD.

Underground cables: constructional features of LT and HT cables; capacitance of single-core cable; grading of cables, power factor and heating, capacitance of 3- core belted cable; DC cables; Cable faults and testing.

MODULE IV **PERFORMANCE OF TRANSMISSION LINES** **12 Hours**

Performance of Transmission lines - short line, medium line and long line, equivalent circuits, Phasor diagram, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation; Real and reactive power flow in lines;surge impedance loading; Power circle diagrams; Skin and proximity effects; Ferranti effect; Interference with neighboring communication circuits; Corona discharge characteristics, Critical voltage and corona loss; Methods of voltage control

MODULE V **DISTRIBUTION SYSTEMS AND SUBSTATION** **12 Hours**

Distribution systems: General Aspects, Radial and ring main systems; Calculation of voltage in distributors with concentrated and distributed loads, Kelvin's law; Techniques of voltage control and power factor improvement.

Substation: Types, typical key diagram of an 11kV / 400V substation; Grounding; Recent trends in transmission and distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

TOTAL: 60 HOURS

REFERENCES:

1. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, seventh edition 2017.
2. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2011.
3. D.P.Kothari, I.J. Nagarath, "Power System Engineering", TataMcGraw Hill Publishing Company limited, New Delhi, 2nd edition. 2008.
4. HadiSaadat, 'Power System Analysis,' PSA Publishing; Third Edition, 2010.
5. S. L. Uppal and S. Rao"Electrical Power" Khanna Publishers, 15th Edition, 1987.
6. http://nptel.ac.in/courses/108108099/, http://nptel.ac.in/courses/108105053/2

1902EE402	SYNCHRONOUS AND ASYNCHRONOUS MACHINES	L	T	P	C
		3	2	0	4

MODULE I **SYNCHRONOUS GENERATOR** **12 Hours**

Constructional details-types of rotors;EMF equation; specifications; Armature reaction-phasor diagram; Predetermination of voltage regulation– EMF, MMF, ZPF & ASA methods; Load characteristics; Power transfer equations and capability curves; Two reaction theory;Slip test;Parallel operation and synchronization to infinite bus bar; Application; Maintenance.

MODULE II **SYNCHRONOUS MOTOR** **12 Hours**

Principle of operation, torque equation, power input and power developed equations; V and Inverted V curves; Effect of varying load and Excitation; Load test and characteristics; Starting methods; Hunting; Synchronous condenser; Applications. Synchronous induction motor.

MODULE III **THREE PHASE INDUCTION MOTOR** **12 Hours**

Constructional details, types, principle of operation, rotating magnetic field, slip; Equivalent circuit; torque equation, Torque-Slip characteristics-Effect of supply voltage and rotor resistance on torque; Circle diagram, separation of losses; Tests; Cogging and crawling; Induction generator; Double cage deep bar induction motor.Role of asynchronous motor in industrial sector - Case study.

MODULE IV **STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR** **12 Hours**

Need for starter; Types of starters – star delta starter, auto transformer starter, DOL starter, Comparison of starters; Speed control – voltage control, frequency control, pole changing, cascaded connection, v/f control, slip power recovery scheme; Braking methods.Safety procedures for installation of starters. Speed control applications in industry - Case study.

MODULE V **SINGLE PHASE INDUCTION MOTOR & FRACTIONAL HP MOTORS** **12 Hours**

Principle of single phase induction motors-Rotating vs alternating magnetic field; double field revolving theory; Types or Starting methods; Construction; Torque - speed characteristics; equivalent circuit.

Construction and working of fractional HP motors: Hysteresis motor; stepper motor; universal motor; linear induction motor.Role of single phase induction motor in industrial and house hold appliances. Use of capacitor bank- Applications of single phase induction motor- Case study.

TOTAL: 60 HOURS

REFERENCES:

1. Fitzgerald A.E,CharlesKingsley, Stephen. D.Umans, „Electric Machinery", Tata McGraw-Hill Education Pvt. Ltd. 6th Edition, 2015.
2. Kothari D.P and I.J. Nagrath, "Electric Machines",McGraw -Hill,5th Edition, 2017.
3. BhimbhraP.S, "ElectricalMachinery",HannaPublishers,7thEdition, 2009.
4. Bandyopadhyay M.N, "Electrical Machines-Theory and Practice", PHI Learning Pvt. LTD., New Delhi, 2014
5. Charles A. Gross, "Electric /Machines", CRC Press, First Edition, 2006.
6. https://nptel.ac.in/courses/108/106/108106072/

1902EE403	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

MODULE I **FABRICATION OF INTEGRATED CIRCUITS** **9 Hours**

IC classification; Fundamental of monolithic IC technology; Epitaxial growth, masking and etching, diffusion of impurities; realization of monolithic ICs and packaging; fabrication of diodes, capacitance, resistance and FET.

MODULE II **OPERATIONAL AMPLIFIER** **9 Hours**

Op-Amp- functional block diagram, ideal and practical op-amp; IC741- Pin diagram, Features, Interpretation of IC 741 datasheet; Characteristics-CMRR, open loop gain, slew rate, transfer characteristics, input bias and output offset voltage, offset compensation techniques, frequency response characterization, frequency compensation.

MODULE III **APPLICATIONS OF OPERATIONAL AMPLIFIERS** **9 Hours**

Inverting and non-inverting amplifiers, voltage follower, summing amplifier, differential amplifier, instrumentation amplifier; Comparators; Integrator and differentiator; Precision rectifier; Logarithmic and anti logarithmic amplifiers. Sinusoidal oscillators - phase shift, Wein bridge & Hartley; sample and hold circuit; clipper and clamper; Schmitt trigger.

MODULE IV **SIGNAL CONVERSION APPLICATIONS** **9 Hours**

V/F and F/V converters; V/I and I/V converter; D/A converter - weighted resistor type, R-2R ladder type, inverted R-2R, comparison; A/D converters- flash type, successive approximation type, single slope type, dual slope type, A/D converter using voltage-to-time conversion, comparison**.**

Active filters-Low pass, High pass, Bandpass and Band reject filters; First, second and higher order filters.

MODULE V **SPECIAL FUNCTION INTEGRATED CIRCUITS** **9 Hours**

555 Timer - functional block diagram and description, astable, monostable and bistable operations; 566 voltage controlled oscillator; 565 PLL - functional block diagram, principle of operation, characteristics; IC voltage regulators – regulation, need for voltage regulation; LM78XX, 79XX fixed voltage regulators; LM 317 & LM723; Interpretation of IC data sheets.

Total: 45 Hours

REFERENCES:

1. D Roy Choudhury and SheilB.Jani, “Linear Integrated Circuits” 4th Edition, New Age International, New Delhi, 2014.
2. S Salivahanan and V S KanchanaBhaaskaran, “Linear Integrated Circuits”, 2nd Edition, McGraw-Hill Education, 2014.
3. RamakantA.Gayakward, “Op-amps and Linear Integrated Circuits”, 4thEdition, PHI Learnings, 2003.
4. B Somanathan Nair, “Linear Integrated Circuits: Analysis, Design and Applications”, Wiley, 2009.
5. Floyd and Buchla, “Fundamentals of Analog Circuits”, Pearson, 2013.
6. James M. Fiore, “Operational Amplifiers & Linear Integrated Circuits: Theory and Application / 3E”, November 2018.
7. Microelectronic circuits-by A.S.Sedra and K.C.Smith
8. http://nptel.ac.in/courses/117107094/

1902EE404	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I **AMPLITUDE MODULATION SYSTEMS** **9 Hours**

Need for modulation – Classifications of modulation techniques-Generation and detection: AM, DSBSC, SSB-SC, VSB-Comparison of Amplitude modulation systems- AM transmitters-AM receivers.

MODULE II **ANGLE MODULATION SYSTEMS** **9 Hours**

Frequency modulation: Narrowband and wideband FM- Phase Modulation- Generation of FM signal:Direct FM, indirect FM- Demodulation of FM signals -FM stereo multiplexing- FM transmitters- FM receivers.

MODULE III **SAMPLING AND QUANTIZATION** **9 Hours**

Sampling Process – Aliasing – Instantaneous sampling – Natural Sampling –Flat Sampling – Quantization of signals –sampling and quantizing effects –channel effects – SNR for quantization pulses – data formattingtechniques –Time division multiplexing

MODULE IV **DIGITAL TRANSMISSION** **9 Hours**

Baseband Transmission: Wave form representation of binary digits - PCM, DPCM, DM, ADM systems, Pass band Transmission: ASK, FSK, PSK, QPSK, DQPSK, MSK, QAM , Noise performance of ASK, FSK, PSK,QPSK, DQPSK, MSK, QAM

MODULE V **CELLULAR COMMUNICATION** **9 Hours**

Introduction, Frequency reuse, Cell Assignment techniques, Hand off Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage and capacity in cellular systems. Multiple Accesstechniques: FDMA, TDMA, CDMA, SDMA

Total: 45 Hours

REFERENCES:

1. G.Kennedy and B.Davis, Electronic Communication Systems, fourth Edition, Tata McGraw-Hill -2008.
2. Simon Haykin, Communication Systems, John Wiley, 2001.
3. Simon Haykin, “Digital Communications”, John Wiley, 2006.
4. Amitabha Bhattacharya, “Digital Communication”, Tata McGraw Hill, 2006.
5. Rappaport. T.S., “Wireless Communications: Principles and Practices”, Second Edition, PHI, 2014
6. https://nptel.ac.in/courses/108/104/108104100/

1901EE405	BIOLOGY FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO CELL BIOLOGY **09 Hours**

Basic Cell- chromosomes, genes, cell cycle and cell division phase, cell differentiation: evidences of evolution, theories of evolution, biological evolution; recombination- chromosome mapping, natural selection, mutation; Genetic algorithms; evolutionary algorithms.

MODULE II SENSORY FUNCTIONS OF HUMAN ORGANS **12 Hours**

Eye- visual acuity, visual perception,colour perceptions**;** camera, Digital Camera-;introduction to Image processing Ear- Auditory perception, equilibrioception; introduction to Signal processing Brain- neuron, cerebellum and cerebrum; motor control-,sensory, regulation-,Language; lateralisation-Emotion, cognition; Artificial neural network; introduction to Machine learning, Natural language processing .

MODULE III MUSCULAR AND LOCOMOTIVE FUNCTIONS **09 Hours**

Producing movement- body movements, Special movements-,Stabilizing joint, locomotion; Swimming of fish, active flight, gliding, soaring of birds ; Robots-degree of freedom, rigid transformations- kinematics, inverse kinematics- jacobians; trajectory following

MODULE IV BIO ELECTRONICS ENGINEERING **08 Hours**

Overview of bioelectronics; analogy between semiconductor and biological materials; advanced bio electronic devices; introduction to bio signals; Bio medical imaging,, X-ray imaging, computed tomography, ultrasonic imaging systems, magnetic resonance imaging system ;introduction to bio chip technology

MODULE V BIO MEDICAL INSTRUMENTATION **07 Hours**

Introduction to bio electrical engineering- sensors and actuators-remote sensing role of electrical instrumentation in Biology –theraupticequipments -EEG-ECG-EMG ;Introduction to Micro electro mechanical system (MEMS)

TOTAL: 45 HOURS

REFERENCES:

1.L.Cromwell, F. J. Weibell, E.A. Pfeeiffer. “Biomedical Instrumentation and Measurement” Pearson Education, 2003

2. Guyton and Hall Textbook of Medical Physiology 13th Edition by John E. Hall Elsevier.

3.Biochips: Technology and Applications, Wan-Li Xing , Jing Cheng, Springer; 2003 edition (11 July 2003

4. Biosensors and Bioelectronics, ChandranKarunakaranKalpana Bhargava Robson Benjamin, Elsevier publications book series.

5. Andrew A. Biewener , Sheila N. Patek " Animal Locomotion" Second edition Oxford University Press.

6. Biology for Engineers: As per Latest AICTE Curriculum-Wiley Editorial.

7. Learn Physiology Online-Harvard Medical School (onlinelearning.hms.harvard.edu).

9. https://www.edx.org/course/essential-human-biology-cells-and-tissues (University of Adelaide).

1902EE451	SYNCHRONOUS AND ASYNCHRONOUS MACHINES LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. No load, blocked rotor test and load test on single phase induction motor.
2. Parallel operation of alternators/ synchronization of alternator with infinite bus bar
3. No load, blocked rotor test and load test on three phase induction motor.
4. Synduction motor
5. Separation of no load losses ofthree phase induction motor.
6. Voltage regulation of an alternator by EMF and MMF method.
7. Voltage regulation of an alternator by ZPF and ASA method.
8. V & inverted V curve of three phase synchronous motor.
9. Determination of Xd,Xq and regulation of a salient pole alternator.
10. Determine the characteristics of three phase induction generator.
11. Speed control of single phase/three phase induction motor.

TOTAL: 30 HOURS

ADDITIONAL EXPERIMENTS:

Determination of negative & zero sequence reactance of a three phase alternator.

REFERENCES:

1. Suresh Babu.P.J, “Electrical Machinery Lab II Manual”, 2018.
2. Kothari.D.P&Umre.B.S “Laboratory manual for electrical machines”, I.K international Publishing House (P) Ltd. 2nd Edition, 2017

1902EE452	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. Inverting and non-inverting amplifiers using op-amp.
2. Adder, subtractor and comparators using op-amp.
3. Sinusoidal oscillators using op-amps.
4. Schmitt trigger using op-amp.
5. Weighted resistor type DAC and R-2R ladder type DAC
6. Astable and monostablemultivibrators using NE555 timer.
7. Implementation of Boolean functions, Adder/ Subtractor circuits
8. Design and implementation of code converters using logic gates
9. Design and implementation of encoder and decoder using logic gates.
10. Construction and verification of 4 bit ripple counter (up/down).
11. Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip-flops.
12. Design and implementation of Multiplexer and De-multiplexer using logic gates.

TOTAL: 30 HOURS

ADDITIONAL EXPERIMENTS :

1. Applications of 565 Phase locked loop (PLL)
2. Applications of 566 voltage controlled oscillator (VCO)
3. Adjustable voltage regulators using LM317 and LM723.

REFERENCES:

1. Dr. T. Suresh Padmanabhan and Mr.K.Nandakumar, “Analog and Digital Integrated Circuits Manual”, 2018.
2. D Roy Choudhury and SheilB.Jani, “Linear Integrated Circuits” 4th Edition, New Age International, New Delhi, 2014.
3. James M. Fiore, “Operational Amplifiers & Linear Integrated Circuits: Theory and Application / 3E”, November 2018.
4. RamakantA.Gayakward, “Op-amps and Linear Integrated Circuits”, 4thEdition, PHI Learnings, 2003.

1904GE451	LIFE SKILLS: VERBAL ABILITY	L	T	P	C
		0	0	2	1

MODULE1 VOCABULARY USAGE **6 hours**

Introduction - Synonyms and Antonyms based on Technical terms – Single word Substitution – Newspaper, Audio and video listening activity.

MODULE 2 COMPREHENSION ABILITY **6 hours**

Skimming and Scanning – Social Science passages – Business and Economics passages – latest political and current event based passages – Theme detection – Deriving conclusion from passages.

MODULE 3 BASIC GRAMMAR AND ERROR DETECTION **6 hours**

Parallelism – Redundancy – Ambiguity – Concord - Common Errors – Spotting Errors – Sentence improvement – Error Detection FAQ in Competitive exams.

MODULE 4 REARRANGEMENT AND GENERAL USAGE **6 hours**

Jumble Sentences – Cloze Test - Idioms and Phrases – Active and passive voice – Spelling test.

MODULE 5 APPLICATION OF VERBAL ABILITY **6 hours**

Business Writing - Business Vocabulary - Delivering Good / Bad News - Media Communication - Email Etiquette – Report Writing - Proposal writing – Essay writing– Indexing –Market surveying.

TOTAL: 30 HOURS

REFERENCES:

1. Arun Sharma and MeenakshiUpadhyav, How to Prepare for Verbal Ability and Reading Comprehension for CAT, McGrawHill Publication, Seventh Edition 2017
2. R S Aggarwal and Vikas Aggarwal , Quick Learning Objective General English ,S.Chand Publishing House, 2017
3. Dr.K.Alex , Soft Skills, S.Chand Publishing House, Third Revise Edition, 2014
4. Raymond Murphy, Essential English Grammar in Use, Cambridge University press, New Delhi, Third Edition , 2007

1901MCX01	ENVIRONMENTAL SCIENCE (Common to all Branches of B.E/ B.Tech)	L	T	P	C
		2	0	0	0

MODULE I **ECOSYSTEMS AND BIODIVERSITY** **10 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place

MODULE II **NATURAL RESOURCES** **10 Hours**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Documentation of the effect of modern Agriculture in your nearby Village

MODULE III **ENVIRONMENTAL POLLUTION** **9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution - Mitigation procedures- Control of particulate and gaseous emission, Control of SO_X, NO_x, CO and HC) -Technology for capturing CO_2 (metallo organic frame works)(b) Water pollution – Waste water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies.
Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural.

MODULE IV **SOCIAL ISSUES AND THE ENVIRONMENT** **8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management -environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments-scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards- disaster management: floods, earthquake- Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India)

MODULE V **HUMAN POPULATION AND THE ENVIRONMENT** **8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA) -GIS-remote sensing-role of information technology in environment and human health – Case studies.
Documentation study of the Human health and the environment in nearby Hospital (Statistical report)

TOTAL: 45 HOURS

REFERENCES:

1. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi,2007.
4. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
5. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006
6. Ravikrishnan“Environmental Science and Engineering” Sri Krishna Hi-tech Publishing Company Pvt .
7. https://en.wikipedia.org/wiki/Carbon_capture_and_storage.

1902EE501	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

MODULE I BASICS OF MEASUREMNT SYSTEM **9 Hours**

Elements of a generalized measurement system- Primary sensing element, variable conversion element, variable manipulation element, data transmission and presentation element; Static and dynamic characteristics; Units of measurement systems; Errors- types, measurements, remedial methods, numerical problems; Calibration - Calibration methodology; Standards-National and international.

MODULE II ELCTRICAL AND ELECTRONICS INSTRUMENTS **9 Hours**

Measuring instruments- Classification of measuring instruments, essential requirements of an instrument; Principle and types of analog and digital voltmeter, ammeter and multimeter; Single and three phase watt meter and energy meter; Magnetic measurements; Instrument transformers-CT and PT, extension of range; Frequency meters-Analog and digital frequency meters; phase sequence indicators; power factor meters.

MODULE III COMPARISON TYPE MEASURING INSTRUMENTS **9 Hours**

Principle of comparison type instruments; Potentiometers-DC and AC potentiometers; Bridges - DC and AC bridges, transformer ratio bridges, self-balancing bridges; Interference- Electrostatic, Electromagnetic and ground interference, measurement of radiated interference; Grounding techniques

MODULE IV STORAGE AND DISPLAY DEVICES **9 Hours**

Display devices- LED and LCD display, comparison between LED and LCDs, dot matrix display; Recorders- Strip chart recorders, single point and multi-point recorders, X-Y recorders, magnetic tape recorders; Digital recorders; Oscilloscope-CRO, digital CRO and CRO measurements; Data loggers; Interpretation of datasheet of commercially available storage and display devices.

MODULE V TRANSDUCERS AND DATA ACQUISITION SYSTEMS **9 Hours**

Transducers-Classification, characteristics and selection factors; Passive transducers- Resistive, capacitive and inductive transducers**;** Active transducers-Piezo electric,photo electric and thermo electric transducers; Hall effect transducer; Elements of data acquisition system- Case study; A/D and D/A converters; Smart sensors; Interpretation of datasheet of commercially available transducers and DAS.

TOTAL: 45 Hours

REFERENCES:

1. A.K. Sawhney and Puneet Sawhney, “A Course in Electrical, Electronic Measurements & Instrumentation”, Dhanpat Rai and Co., 2012.
2. J. B. Gupta, “A Course in Electronic and Electrical Measurements”, S. K. Kataria &Sons, Delhi, Jan 2012.
3. H.S. Kalsi, “Electronic Instrumentation”, Tata McGraw Hill, 2nd Edition, 2018.
4. Alan. S. Morris, “Principles of Measurements and Instrumentation”, 2nd Edition, Prentice Hall of India, 2003.
5. Murthy D.V.S., “Transducers and Instrumentation”, Prentice Hall of India, 13th Printing, 2018.
6. https://nptel.ac.in/courses/108/105/108105064//

1902EE502	LINEAR CONTROL SYSTEMS	L	T	P	C
		3	2	0	4

MODULE I SYSTEMS AND THEIR REPRESENTATION **12 Hours**

Basic elements in control systems; Open and closed loop systems; Transfer function- Electrical and mechanical transfer function models, electrical analogy of mechanical systems, block diagram reduction techniques, signal flow graphs.

MODULE II TIME RESPONSE **12 Hours**

Time response-Time domain specifications, types of test inputs, first and second order system responses; Error coefficients- Generalized error series, steady state error; Simple time response analysis using MATLAB.

MODULE III FREQUENCY RESPONSE **12 Hours**

Frequency response –Frequency domain specifications, Bode plot, polar plot, determination of closed loop response from open loop response; Correlation between frequency domain and time domain specifications; Simple frequency response analysis using MATLAB.

MODULE IV STABILITY **12 Hours**

Stability- Concept, relative stability, characteristics equation, Routh Hurwitz criterion, root locus construction, Nyquist stability criterion; Simple root locus curves in MATLAB.

MODULE V DESIGN OF COMPENSATORS AND CONTROLLERS **12 Hours**

Compensators - Lag, lead and lag-lead networks, design procedure; Simple problems in MATLAB.
Controllers- P, PI and PID control, design procedure, tuning of controllers, Simple problems in MATLAB.

TOTAL: 60 HOURS

REFERENCES:

1. M.Gopal, “Control Systems, Principles and Design”, 4th Edition, Tata McGraw Hill, New Delhi, 2012.
2. S.K.Bhattacharya, “Control System Engineering”, 3rd Edition, Pearson Publications, New Delhi 2013.
3. K.Ogata, “Modern Control Engineering”, 5th Edition, Pearson Prentice Hall, New Delhi, 2012.
4. Richard C.Dorf and Robert H. Bishop, “Modern Control Systems”, 12th Edition, Pearson Prentice Hall, 2012.
5. Benjamin C.Kuo, “Automatic Control Systems”, 7th Edition, Pearson Prentice Hall, New Delhi, 2010.
6. https://nptel.ac.in/courses/107/106/107106081/

1902EE503	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

MODULE I **POWER SEMICONDUCTOR DEVICES** **9 Hours**

Introduction to power semiconductor devices; Power diodes, power transistors, Power MOSFETs, IGBTs, SCRs, Triacs, GTOs, IGCT; Static and Dynamic characteristics; Thermal characteristics; losses in the devices.

SCRs- Symbol, construction, static and dynamic characteristics; Two transistor analogy; Snubber circuits; Series and parallel operation of SCRs; Data sheet interpretation of commercially available SCRs.

MODULE II **PHASECONTROLLED CONVERTERS** **9 Hours**

Principle of phase control; Single phase and three phase half wave and full wave converters with R,RL and RLE loads; Estimation of average and RMS values of load voltage, load current; Performance parameters for converters; Effect of freewheeling diodes; Effect of source inductance; Dual converters; Applications.

MODULE III **DC TO DC CONVERTERS** **9 Hours**

DC choppers- Principle of step-up and step-down choppers, control strategies; Classification of choppers- Single quadrant, two quadrant and four quadrant DC choppers, Buck, Boost and Buck boost converters; SMPS; Voltage and current commutated choppers; Multiphase chopper; LUO converter; SEPIC converter; Applications.

MODULE IV **INVERTERS** **9 Hours**

Types of inverters; Operation of single phase VSI, three phase VSI (120 and180-degree modes); Inverter output voltage control; CSIs- Auto sequential CSI; Introduction to MLIs; Pulse width modulation techniques- Single, multiple, sinusoidal modulation; Establishment and solving of NR method based SHEPWM equations; Harmonic elimination techniques; Applications.

MODULE V **AC TO AC CONVERTERS** **9 Hours**

AC voltage controllers-Single phase and three phase controllers with R and RL loads; Sequence control of AC regulators –Two stage sequence control, multistage sequential control.

Cycloconverters: Step-down and step-up cyclo converters; Introduction to matrix converters; Applications.

TOTAL: 45 HOURS

REFERENCES:

1. Rashid M H, “Power Electronics- Circuits, Devices and Applications”, Prentice Hall of India, New Delhi, 2011.
2. P.S.Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi, 2006.
3. Vedam Subramanyam, “Power Electronics”, New Age International, New Delhi, 1996.
4. M.D. Singh and K.B. Khanchandani, “Power Electronics”, 2nd Edition, Tata McGraw Hill, New Delhi, 2017.
5. Ned Mohan, Tore.M.Undeland, William.P.Robbins, “Power Electronics: Converters, Applications and Design”, John Wiley and Sons, 3rd Edition, 2003.
6. https://nptel.ac.in/courses/108/102/108102145/

1903EE002	ELECTRICAL MACHINE DESIGN	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION TO MACHINE DESIGN **9 Hours**

Major considerations in electrical machine design; Electrical engineering materials-electrical and magnetic properties; Space factor; Choice of specific electrical and magnetic loadings; Thermal considerations; Rating of machines; Standard specifications; Design flow chart.

MODULE II DC MACHINES **9 Hours**

Design of DC machines- General considerations, Output equation, Main dimensions, limitations of D and L, Choice of specific electric and magnetic loadings, Magnetic circuit calculations, Carter's coefficient, Net length of iron, Real and apparent flux densities, Selection of number of poles, Design of field system, Armature, Design of commutator and brushes, Computer aided design of DC machine.

MODULE III TRANSFORMERS **9 Hours**

Design of Transformers-General considerations, Output equation, KVA output for single phase and three phase transformers, Window space factor, Design of core and winding, Overall dimensions, No load current, Temperature rise in transformers, Design of tank and cooling tube, Computer aided design of transformer.

MODULE IV INDUCTION MOTORS **9 Hours**

Design of Induction motors- General considerations, Output equation, Choice of average flux density, Main dimensions, Length of air gap, rules for selecting rotor slots of squirrel cage machines, Design of rotor bars and slots, Design of end rings, Design of wound rotor, Magnetic leakage calculations, Leakage reactance of poly phase machines, Magnetizing current and short circuit current, Computer aided design of three phase induction motors; Design of single-phase induction motor.

MODULE V SYNCHRONOUS MACHINES **9 Hours**

Design of Synchronous machines-General considerations, Output equation, Choice of electrical and magnetic loading, Main dimensions, Short circuit ratio, Stator design, Stator parameters, Estimation of air gap length, Design of rotor, Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turbo alternators and its rotor design, Computer aided design of synchronous machines.

TOTAL: 45 HOURS

REFERENCES:

1. Sawhney. A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, 6th edition, New Delhi, 2010.
2. M.V.Deshpande, "Design and Testing of Electrical Machines", Prentice Hall India, 3rd edition, 2009.
3. A.Shanmuga Sundaram, R.Palaniand G.Gangadharan, "Electrical Machine Design Data Book", New Age International Pvt. Ltd., First edition, 2011.
4. R.K.Agarwal, "Principles of Electrical Machine Design", S K Kataria and Sons, New Delhi, 2009.
5. Sen, S.K., "Principles of Electrical Machine Designs with Computer Programs", Oxford and IBH Publishing Co. Pvt. Ltd., 2nd edition, New Delhi, 2006.
6. https://nptel.ac.in/courses/108/102/108102146/
7. https://nptel.ac.in/courses/108/105/108105131/

1901GE501	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

CIVIL ENGINEERING

MODULE I SURVEYING AND CIVIL ENGINEERING MATERIALS **9 Hours**

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

MODULE II BUILDING COMPONENTS AND STRUCTURES **9 Hours**

Foundations: Types, Bearing capacity – Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

MECHANICAL ENGINEERING

MODULE III POWER PLANT ENGINEERING **9 Hours**

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

MODULE IV IC ENGINES **9 Hours**

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

MODULE V REFRIGERATION AND AIR CONDITIONING SYSTEM **9 Hours**

Terminology of Refrigeration and Air Conditioning– Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

TOTAL: 45 HOURS

REFERENCES:

1. Ramamrutham S., “Basic Civil Engineering”, Dhanpat Rai Publishing Co. (P) Ltd. 1999.
2. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.
3. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam, 2000.
4. Shantha Kumar S R J., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.
5. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 1996.

1902EE551	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Measurement of resistance using bridge networks.
2. Measurement of inductance using bridge networks.
3. Measurement of capacitance using bridge networks/phase measurements.
4. Perform signal conditioning by using ADC and DAC.
5. Temperature/pressure/displacement sensors.
6. Extension of range of voltmeters and Ammeters.
7. Measurement of energy (single and three phases).
8. AC position control systems.
9. DC position control systems.
10. Transfer function of armature-controlled DC motor.
11. Transfer function of field-controlled DC motor.
12. Closed loop control system using PI/PID controller/ Flow controller.

TOTAL: 30 HOURS

REFERENCES:

1. T. Suresh Padmanabhan, “Control and Instrumentation Laboratory Manual”, EGSPEC, 2020.
2. S.K.Bhattacharya, “Electrical Measurement and Control Manual”, Vikas publishing house, New Delhi, 2015

1904GE551	LIFE SKILLS: APTITUDE – 1	L	T	P	C
	(Common to All Branches)	0	0	2	1

MODULE I **INTRODUCTION TO NUMBER SYSTEM, BASIC SHORTCUTS OF ADDITION, MULTIPLICATION, DIVISION** **6 Hours**

Classification of numbers – Types of Numbers - Divisibility rules - Finding the units digit - Finding remainders in divisions involving higher powers - LCM and HCF Models - Fractions and Digits – Square, Square roots – Cube, Cube roots – Shortcuts of addition, multiplication, Division.

MODULE II **RATIO AND PROPORTION, AVERAGES** **6 Hours**

Definition of Ratio - Properties of Ratios - Comparison of Ratios - Problems on Ratios - Compound Ratio - Problems on Proportion, Mean proportional and Continued Proportion Definition of Average - Rules of Average - Problems on Average - Problems on Weighted Average - Finding average using assumed mean method.

MODULE III **PERCENTAGES, PROFIT AND LOSS** **6 Hours**

Introduction Percentage - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions - Problems on percentages - Problems on Profit and Loss percentage- Relation between Cost Price and Selling price - Discount and Marked Price - Two different articles sold at same Cost Price - Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price.

MODULE IV **CODING AND DECODING, DIRECTION SENSE** **6 Hours**

Coding using same set of letters - Coding using different set of letters - Coding into a number - Problems on R-model - Solving problems by drawing the paths - Finding the net distance travelled - Finding the direction - Problems on clocks - Problems on shadows - Problems on direction sense using symbols and notations.

MODULE V **NUMBER AND LETTER SERIES NUMBER AND LETTER ANALOGIES, ODD MAN OUT** **6 Hours**

Difference series - Product series - Squares series - Cubes series - Alternate series - Combination series - Miscellaneous series - Place values of letters - Definition of Analogy - Problems on number analogy - Problems on letter analogy - Problems on verbal analogy - Problems on number Odd man out - Problems on letter Odd man out - Problems on verbal Odd man out

TOTAL: 30 HOURS

REFERENCES:

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
4. R S Agarwal, 'Quantitative Aptitude for Competitive Examinations', Revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and Indu Sijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

ASSESSMENT PATTERN :

1. Two tests will be conducted (25 * 2) - 50 marks
2. Five assignments will be conducted (5*10) - 50 Marks.

1901MCX03	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
	(Common to All Branches)	2	0	0	0

MODULE I INTRODUCTION TO CULTURE **6 Hours**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

MODULE II INDIAN LANGUAGES, CULTURE AND LITERATURE **6 Hours**

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature.

MODULE III RELIGION AND PHILOSOPHY **6 Hours**

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only).

MODULE IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) **6 Hours**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India.

MODULE V EDUCATION SYSTEM IN INDIA **6 Hours**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

TOTAL: 30 HOURS

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

1902EE601 **SOLID STATE DRIVES**

L	T	P	C
3	0	0	3

MODULE I **DRIVE CHARACTERISTICS** **8 Hours**

Electric drives - Classification, elements of electrical drive, equations governing motor load, torque components; Classes of duty-Thermal overloading, load variations; Steady state stability; Multi quadrant dynamics; Typical load torque characteristics - Constant torque, torque proportional to speed, fan load, torque inversely proportional to speed; Thermal model of electrical motors and load equalization; Selection of motor rating.

MODULE II **DC MOTOR DRIVE** **9 Hours**

History of DC drives; Ward-Leonard control; Constant torque and constant HP operation of DC drives

Converter fed drive- Review of one and two quadrant converter and its characteristics; Steady state analysis of single phase and three phase converter fed separately excited dc motor drive - Continuous and discontinuous conduction, four quadrant operations of converter; Armature control, field control and regenerative braking in DC motors using phase angle control.

Chopper fed drive- Review of dc chopper and its control strategies; Motoring mode, braking mode and four quadrant operation of chopper fed drive.

MODULE III **CLOSED LOOP CONTROL OF DC DRIVE** **8 Hours**

Control structure of dc drive; Armature voltage and field control of separately excited dc motor drive; Transfer function of separately excited dc motor and converter; Design of controllers - Speed controller and current controller.

MODULE IV **INDUCTION MOTOR DRIVE** **12 Hours**

Review of induction motor equivalent circuit and torque speed characteristics; Speed control of induction motor drive - Stator voltage control, v/f control, VSI fed induction motor drive, cyclo converter control and vector control - Block diagram approach; Impact of rotor resistance on induction motor speed torque curve; Closed loop control of induction motor drive- Slip power recovery schemes.

MODULE V **SYNCHRONOUS MOTOR DRIVE** **8 Hours**

V/f and self-control of synchronous motor drive; Margin angle control and power factor control; VSI and CSI fed synchronous motor drive; Permanent magnet synchronous motor - Construction, types, BLPM DC motor and BLPM AC motor.

TOTAL: 45 HOURS

REFERENCES:

7. G.K Dubey, “Fundamentals of Electrical Drives”, 2nd Edition, Narosa Book Distributors, 2013.
8. N. K. De, P. K. Sen, “Electric Drives”, 16th Edition, PHI Learning Pvt. Ltd., 2014.
9. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Pearson Education, 2015.
10. Bimal K. Bose “Modern Power Electronics and AC Drives”, Pearson Education, Second Edition, 2003.
11. P.C Sen “Thyristor DC Drives”, John wiely & Sons, New York, 1981.
12. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, New York, 2010.
13. https://nptel.ac.in/courses/108/104/108104140/

1902EE602 **POWER SYSTEM ANALYSIS**

L	T	P	C
3	2	0	4

MODULE I **MODELING OF POWER SYTEM COMPONENTS** **12 Hours**

Power system components; Indian power scenario; Single line diagram - Per unit representation, per unit impedance diagram; Representation of off nominal transformers; Formation of bus admittance matrix.

MODULE II **LOAD FLOW ANALYSIS** **12 Hours**

Need for load flow studies; Buses - Classification of Buses; Formulation of power flow problems; Power flow solutions - Gauss seidel method, Newton Raphson method, Fast decoupled method; comparison of methods.

MODULE III **SYMMETRICAL FAULT ANALYSIS** **12 Hours**

Nature of symmetrical fault; Short circuit capacity; Bus impedance matrix using building algorithm; Sequence impedances of transmission lines, Transformers and synchronous machines; Symmetrical fault calculation using bus impedance matrix.

MODULE IV **UNSYMMETRICAL FAULT ANALYSIS** **12 Hours**

Symmetrical component; Sequence impedance; Bus impedance matrix of zero sequence, positive sequence and negative sequence network; Analysis of unsymmetrical fault - Single line to ground fault, line to line fault, double line to ground fault.

MODULE V **STABILITY STUDIES & COMPUTATIONAL METHODS IN ELECTRICAL POWER SYSTEM** **12 Hours**

Need for stability studies; Swing equation; Equal area criterion; Critical clearing angle and time; Step by step procedure for solving swing equation; Pre-conditions for iterative methods - Sparse matrix solution techniques, numerical stability analysis, least square state estimation, eigen value problems; Methods to improve the stability.

TOTAL: 60 HOURS

REFERENCES:

1. John J. Grainger and W.D. Stevenson Jr., "Power System Analysis", 6th Reprint, Tata McGraw-Hill, 2010.
2. Hadi Sadat, "Power System Analysis", 21st Reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
3. lle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", 2nd Edition Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.
4. C.A.Gross, "Power System Analysis," Wiley India, 2011.
5. Dr. S. Sivanagaraju, B.V. Rami Reddy, "Electrical Power System Analysis", Laxmi Publications (P) Ltd 2007.
6. https://nptel.ac.in/courses/108/105/108105067/

1902EE603	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

MODULE I **8085 MICROPROCESSOR** **9 Hours**

Evolution of microprocessors; 8085 Microprocessor - Pin diagram, architecture, interrupts, memory organization and I/O organization; Introduction to Zilog and Motorola based 8-bit processors-features.

MODULE II **PROGRAMMING OF 8085** **9 Hours**

Instruction set - Data transfer, data manipulation and control instructions; Addressing modes; Timing diagram; Programming concepts: Simple programs - Arithmetic, code conversion, lookup tables and time delay.

MODULE III **8051 MICROCONTROLLER** **9 Hours**

Microcontroller - 8051 Architecture, pin details, memory, ports, counters / timers, interrupts; Instruction set of 8051- Data manipulation instructions, arithmetic, logical and branch control instructions; Addressing modes; Simple programs - Arithmetic, logical, lookup tables and time delay; Comparison- Process and control, programming of 8085 and 8051.

MODULE IV **PERIPHERAL INTERFACING** **9 Hours**

Peripherals and interfacing - Serial and parallel I/O (8251 and 8255), Programmable DMA controller, Programmable interrupt controller, Key board and Display controller, ADC/DAC interfacing.

MODULE V **MICROCONTROLLER BASED SYSTEM DESIGN** **9 Hours**

Applications - Washing machine control, speed control of stepper motor and DC motor, traffic light control; Bluetooth, Zigbee modules integration; SPIC and I^2C; Introduction to PIC controllers.

TOTAL: 45 HOURS

REFERENCES:

7. Ramesh S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with 8085”, 6th Edition, Penram Intl. Publications, 2013.
8. Kenneth Ayala, “The 8051 Microcontroller”, 3rd Edition, Cengage Learning Publications, 2007.
9. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems using Assembly and C”, 2nd Edition, Prentice Hall Publications, 2008.
10. Ray A. K., Bhurchandi K. M., “Advanced Microprocessor and Peripherals”, 3rd Edition, Tata McGraw-Hill Publications, 2013.
11. Sencer Yeralan, Helen Emery, “Programming and interfacing the 8051 Microcontroller”, 1st Edition, Addison-Wesley Publications, 2000.
12. Krishna Kant, “Microprocessors and Microcontrollers, Architecture, Programming and System Design-8085, 8086, 8051, 8096”, 1st Edition, Prentice Hall India Ltd Publications, 2010.
13. https://www.nptel.ac.in/courses/106/105/106105193/
14. https://www.nptel.ac.in/courses/108/102/108102045/

1902EE651 **POWER ELECTRONICS AND DRIVES LABORATORY** **L T P C**

			0	**0**	**2**	**1**

LIST OF EXPERIMENTS

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and Triac.
3. Characteristics of MOSFET and IGBT.
4. AC to DC half-controlled converter fed DC motor.
5. AC to DC full-controlled converter fed DC motor.
6. Step down and step up MOSFET based choppers.
7. IGBT based single phase PWM inverter.
8. IGBT based three phase PWM inverter fed three phase AC Motor.
9. AC voltage controller.
10. Switched mode power converter.
11. Simulation of PE circuits (1Φ & 3Φ semiconverters, 1Φ & 3Φ full converters, DC-DC converters).
12. V/F control of induction motor drive

TOTAL: 30 Hours

REFERENCES:

3. K.Nandakumar, R.Anandaraj, "Power Electronics and Drives Laboratory Manual", 2018
4. Krishnan.R, "Electric Motor and Drives Modeling, Analysis and Control", Prentice Hall of India, 2001.
5. Pillai, S.K., "A First Course on Electrical Drives", Wiley Eastern Limited, 1993.

1902EE652	**MICROPROCESSORS AND MICROCONTROLLERS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

LIST OF EXPERIMENTS

1. Arithmetic operations (8/ 16 bit) using 8085.
2. Finding maxima and minimum numbers in an array using 8085
3. Code conversion using 8085
4. Interfacing with 8085 (ADC, DAC)
5. Arithmetic operations (8 bit) using 8051
6. Pulse generation using 8051.
7. Interfacing 8279 with 8085.
8. Traffic light controller using 8085.
9. Speed control of stepper motor using 8051.
10. Speed control of DC motor using 8051.
11. PWM pulse generation using look up table and microcontroller
12. Arithmetic operations (8/ 16 bit) using 8085.

TOTAL: 30 Hours

REFERENCES:

1. S.Latha, "Microprocessor and microcontroller laboratory Manual", 2018.
2. G.T.Swamy, "Microprocessor 8085 lab manual", Laxmi publications, 1st Edition, 2006.
3. Microprocessor Lab Manual, Rajesh Hegde, Kindle Edition.

1904GE651	LIFE SKILLS: APTITUDE – II	L	T	P	C
	(Common to All Branches)	0	0	2	1

MODULE I **PARTNERSHIP, MIXTURES AND ALLEGATIONS, PROBLEM ON AGES, SIMPLE INTEREST, COMPOUND INTEREST** **6 Hours**

Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule - Problems on Allegation – Problems on ages - Definitions Simple Interest - Problems on interest and amount - Problems when rate of interest and time period are numerically equal - Definition and formula for amount in compound interest - Difference between simple interest and compound interest for 2 years on the same principle and time period.

MODULE II **BLOOD RELATIONS, CLOCKS, CALENDARS** **6 Hours**

Defining the various relations among the members of a family - Solving Blood Relation puzzles - Solving the problems on Blood Relations using symbols and notations - Finding the angle when the time is given - Finding the time when the angle is known - Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days - Framing the year code for centuries - Finding the day of any random calendar date .

MODULE III **TIME AND DISTANCE, TIME AND WORK** **6 Hours**

Relation between speed, distance and time - Converting kmph into m/s and vice versa - Problems on average speed - Problems on relative speed - Problems on trains - Problems on boats and streams - Problems on circular tracks - Problems on races - Problems on Unitary method - Relation between Men, Days, Hours and Work - Problems on Man-Day-Hours method - Problems on alternate days - Problems on Pipes and Cisterns.

MODULE IV **DATA INTERPRETATION AND DATA SUFFICIENCY** **6 Hours**

Problems on tabular form - Problems on Line Graphs - Problems on Bar Graphs - Problems on Pie Charts - Different models in Data Sufficiency - Problems on data redundancy

MODULE V **ANALYTICAL AND CRITICAL REASONING** **6 Hours**

Problems on Linear arrangement - Problems on Circular arrangement - Problems on Double line-up - Problems on Selections - Problems on Comparisons - Finding the Implications for compound statements - Finding the Negations for compound statements- Problems on assumption - Problems on conclusions - Problems on inferences - Problems on strengthening and weakening of arguments.

TOTAL **30 Hours**

REFERENCES:

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
4. R S Agarwal, 'Quantitative Aptitude for Competitive Examinations', revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

ASSESSMENT PATTERN :

1. Two tests will be conducted (25 * 2) - 50 marks
2. Five assignments will be conducted (5*10) - 50 Marks.

PROFESSIONAL ELECTIVE COURSES – I & II

1903EE001	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

MODULE I **SYNCHRONOUS RELUCTANCE MOTOR** **9 Hours**

Constructional features; Types- Axial and radial flux motors; Operating principles; Variable reluctance motors; Voltage and torque equations; Phasor diagram; Performance characteristics; Applications.

MODULE II **STEPPER MOTORS** **9 Hours**

Constructional features; Principal of operation; Variable reluctance motor; Hybrid motor; Single and multi-stack configurations; Torque equations; Modes of excitation; Characteristics; Drive circuits; Microprocessor control of stepper motors; Closed loop control; Concept of lead angle; Applications.

MODULE III **SWITCHED RELUCTANCE MOTORS** **9 Hours**

Evolution of switched reluctance motors; Constructional features; Rotary and linear SRM; Principle of operation; Torque production; Steady state performance prediction; Power converters and their controllers; Methods of rotor position sensing; Sensor less operation; Characteristics and closed loop control; Applications.

MODULE IV **PERMANENT MAGNET BRUSHLESS DC MOTORS** **9 Hours**

Permanent magnet materials; Minor hysteresis loop and recoil line; Magnetic characteristics; Permeance coefficient; Principle of operation; Types, Magnetic circuit analysis; EMF and torque equations; Commutation; Power converter circuits and their controllers; Motor characteristics and control; Applications.

MODULE V **PERMANENT MAGNET SYNCHRONUS MOTOR** **9 Hours**

Principle of operation; Ideal PMSM; EMF and torque equations; Armature MMF; Synchronous reactance; Sine wave motor with practical windings; Phasor diagram; Torque / Speed characteristics; Power controllers; Converter volt-ampere requirements; Applications.

TOTAL: 45 HOURS

REFERENCES:

8. K. Venkataratnam, "Special Electrical Machines", 1st Edition Reprinted, Universities Press (India) Private Limited, Hyderabad, 2013.
9. E.G. Janardanan, "Special Electrical Machines", 1st Edition Reprinted, PHI Learning Private Limited, Delhi, 2014.
10. R.Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2017.
11. J.R.Hendershot and T.J.E.Miller, "Design of Brushless Permanent Magnet Machines", 2nd Edition, Venice Florida: Motor Design Books, 2010.
12. T.J.E.Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1993.
13. T. Kenjo, "Stepping Motors and Their Microprocessor Controls", Clarendon Press London,1984.
14. https://nptel.ac.in/courses/108/102/108102156/

1903EE002 **ELECTRICAL MACHINE DESIGN**

L	T	P	C
3	0	0	3

MODULE I **INTRODUCTION TO MACHINE DESIGN** **9 Hours**

Major considerations in electrical machine design; Electrical engineering materials-electrical and magnetic properties; Space factor; Choice of specific electrical and magnetic loadings; Thermal considerations; Rating of machines; Standard specifications; Design flow chart.

MODULE II **DC MACHINES** **9 Hours**

Design of DC machines- General considerations, Output equation, Main dimensions, limitations of D and L, Choice of specific electric and magnetic loadings, Magnetic circuit calculations, Carter's coefficient, Net length of iron, Real and apparent flux densities, Selection of number of poles, Design of field system, Armature, Design of commutator and brushes, Computer aided design of DC machine.

MODULE III **TRANSFORMERS** **9 Hours**

Design of Transformers- General considerations, Output equation, KVA output for single phase and three phase transformers, Window space factor, Design of core and winding, Overall dimensions, No load current, Temperature rise in transformers, Design of tank and cooling tube, Computer aided design of transformer.

MODULE IV **INDUCTION MOTORS** **9 Hours**

Design of Induction motors- General considerations, Output equation, Choice of average flux density, Main dimensions, Length of air gap, rules for selecting rotor slots of squirrel cage machines, Design of rotor bars and slots, Design of end rings, Design of wound rotor, Magnetic leakage calculations, Leakage reactance of poly phase machines, Magnetizing current and short circuit current, Computer aided design of three phase induction motors; Design of single-phase induction motor.

MODULE V **SYNCHRONOUS MACHINES** **9 Hours**

Design of Synchronous machines- General considerations, Output equation, Choice of electrical and magnetic loading, Main dimensions, Short circuit ratio, Stator design, Stator parameters, Estimation of air gap length, Design of rotor, Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turbo alternators and its rotor design, Computer aided design of synchronous machines.

TOTAL: 45 HOURS

REFERENCES:

1. Sawhney. A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, 6th edition, New Delhi, 2010.
2. M.V.Deshpande, "Design and Testing of Electrical Machines", Prentice Hall India, 3rd edition, 2009.
3. A.Shanmuga Sundaram, R.Palaniand G.Gangadharan, "Electrical Machine Design Data Book", New Age International Pvt. Ltd., First edition, 2011.
4. R.K.Agarwal, "Principles of Electrical Machine Design", S K Kataria and Sons, New Delhi, 2009.
5. Sen, S.K., "Principles of Electrical Machine Designs with Computer Programs", Oxford and IBH Publishing Co. Pvt. Ltd., 2nd edition, New Delhi, 2006.
6. https://nptel.ac.in/courses/108/102/108102146/
7. https://nptel.ac.in/courses/108/105/108105131/

1903EE003 **ELECTRIC AND HYBRID VEHICLES**

L	T	P	C
3	0	0	3

MODULE I **INTRODUCTION TO ELECTRIC VEHICLES** **9 Hours**

Electric and hybrid electric vehicle- History, components, types, environmental impact of electric and HEVs, electric motor and engine performance; EV and ICEV comparison; EV market-Indian scenario.

MODULE II **IC ENGINES AND POWER TRAIN COMPONENTS** **9 Hours**

Vehicle motion and the dynamic equations for the vehicle; Vehicle mass and performance; Gears; Clutches; Brakes and transmission system; Fuel economy characteristics of internal combustion engine; Series drive train; parallel, series parallel and complex drive trains and power flow in each case.

MODULE III **ELECTRIC VEHICLE ARCHITECTURE** **9 Hours**

Basic architecture of EV drive trains; PHEV; Vehicle power plant and transmission characteristics; Power flow in HEVs; Sizing of components for different hybrid drive train topologies; Impact of EVs in utility grid; Case study- Design of a BEV/HEV.

MODULE IV **ENERGY STORAGE SYSTEMS** **9 Hours**

Battery- Energy storage, Simplified models of battery, Battery parameters, Li-ion battery and battery pack management; Flywheels- Modeling for energy storage in HEV/BEV; Fuel cell and supercapacitor-based energy storage; Hybridization of various energy storage devices and its advantages; Energy management system.

MODULE V **ELECTRIC MACHINES AND POWER ELECTRONICS FOR HYBRID ELECTRIC VEHICLES** **9 Hours**

DC Motor drives- Principle of operation, performance and multi-quadrant control; Induction motor drives- Control and applications in EV/HEVs; Permanent magnet motors; Switch reluctance motor drives; Sizing the propulsion motor; Torque, constant power speed ratio and machine dimensions.

Electric drives- Applications in HEV/EVs, Classifications, DC-DC converters for EV and HEV applications, Multi quadrant DC-DC converters, DC-AC inverters for EV and HEV applications, Voltage control of DC-AC inverters using PWM.

TOTAL: 45 HOURS

REFERENCES:

1. Tom Denton, “Electric and Hybrid Vehicles”, 2nd Edition, Routledge, 2020.
2. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, 2nd Edition, Wiley, 2012.
3. Mehrdad Ehsani, Yimin Gao, Stefano Lengo and Kambiz Ebrahimi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, 3rd Edition, CRC Press, 2019.
4. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, 2nd Edition, CRC Press, 2016.
5. https://nptel.ac.in/courses/108/102/108102121/
6. https://nptel.ac.in/courses/108/103/108103009/
7. Tom Denton, “Electric and Hybrid Vehicles”, 2nd Edition, Routledge, 2020.

MICRO ELECTRO MECHANICAL SYSTEM (MEMS)

L	T	P	C
3	0	0	3

MODULE I **MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS** **9 Hours**

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain- flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

MODULE II **ELECTROSTATIC SENSORS AND ACTUATION** **9 Hours**

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications.

MODULE III **THERMAL SENSING AND ACTUATION** **9 Hours**

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

MODULE IV **PIEZOELECTRIC SENSING AND ACTUATION** **9 Hours**

Piezoelectric effect-cantilever piezo electric actuator model-properties of piezoelectric materials-Applications.

MODULE V **CASE STUDIES** **9 Hours**

Piezo resistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.-NEMS Devices Note: Discussions/Exercise/Practice on Workbench: on the basics /device model design aspects of thermal/peizo/resistive sensors etc.

TOTAL: 45 HOURS

REFERENCES:

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.
2. Marc Madou , “Fundamentals of microfabrication”, CRC Press, 1997.
3. Boston , “Micromachined Transducers Source book”, WCB McGraw Hill, 1998.
4. M.H.Bao “Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes”, Elsevier, Newyork, 2000.

1903EE005	AUTOMOTIVE ELECTRONICS	L	T	P	C
		3	0	0	3

MODULE I OVERVIEW OF AUTOMOTIVE SYSTEMS 9 Hours

Overview of automotive industry- Leading players, automotive supply chain, global challenges; Role of technology in automotive electronics and interdisciplinary design, tools and processes; Introduction to modern automotive systems and need for electronics in automobiles; Application areas of electronic systems in modern automobiles - Spark and compression ignition engines, ignition systems, fuel delivery systems, engine control functions, fuel control and electronic systems in engines.

MODULE II AUTOMOTIVE TRANSMISSIONS 9 Hours

Automotive transmissions- Transmission fundamentals, types MT, AT, CVT and DCT vehicle; Braking fundamentals- Vehicle dynamics during braking, hydraulic brake system components, introduction to antilock braking systems; Steering control- Steering system basics, fundamentals of electronically controlled power steering, electronically controlled hydraulic systems and electric power steering systems; CAN communication protocol.

MODULE III AUTOMOTIVE SENSORS AND ACTUATORS 9 Hours

Sensors- Accelerometers, wheel speed, brake pressure, seat occupancy, engine speed, steering wheel angle, vehicle speed, throttle position, turbine speed, temperature, mass air flow (MAF) rate, exhaust gas oxygen concentration, throttle plate angular position, crankshaft angular position/RPM, manifold absolute pressure (MAP) and air bag sensors; Actuators- Relays, solenoids and motors; Chassis control systems and automatic transmission control systems; Passenger safety and convenience; Occupant protection system; Tyre pressure monitoring systems.

MODULE IV MICROCONTROLLERS/MICROPROCESSORS IN AUTOMOTIVE DOMAIN 9 Hours

Critical review and overview of development of microprocessors, microcontrollers and digital signal processors - Architecture of 8/16 bit microcontrollers with emphasis on ports, timer/counters, interrupts, watchdog timers and PWM; Selection of microcontroller/processor for various automotive applications.

MODULE V SAFETY SYSTEMS IN AUTOMOBILES AND DIAGNOSTIC SYSTEMS 9 Hours

Active safety systems- ABS, EBD, TCS, ESP, brake assist; Passive safety systems- Airbag systems, advanced driver assistance systems (ADAS)- Lane departure warning, collision warning, automatic cruise control, pedestrian protection and headlights control; Diagnostics- Fundamentals of diagnostics; Basic wiring system and multiplex wiring system.

TOTAL: 45 HOURS

REFERENCES:

1. Williams. B. Ribbens: "Understanding Automotive Electronics", 6th Edition, Elsevier Science, Newnes Publication, 2003.
2. Robert Bosch, "Automotive Electronics Handbook", John Wiley and Sons, 2004.
3. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
4. James D. Halderman, "Automotive Electricity and Electronics", PHI Publication.
5. Allan Bonnick, "Automotive Computer Controlled Systems, Diagnostic Tools and Techniques", Elsevier Science, 2001.
6. Uwe Kieneke and Lars Nielsen, "Automotive Control Systems: Engine, Driveline and Vehicle", 2nd Edition, Springer Verlag, 2005.
7. David Alciatore and Michael Histand, "Introduction to Mechatronics and Measurement Systems (SIE)", TMH, 2007.
8. Tom Denton, "Advanced Automotive Diagnosis", 2nd Edition, Elsevier, 2006.

1903EE006 **INDUSTRIAL AUTOMATION** **L T P C**
3 0 0 3

MODULE I **PROCESS CONTROL** **9 Hours**

Introduction - Block diagram of process control, definitions of the terms used to describe process control; Control system evaluation, and digital Control; Supervisory control, direct digital control, networked control systems, and distributed digital control; Smart sensor; Data acquisition systems - DAS hardware, DAS software; Data logger.

MODULE II **CONTROLLER PRINCIPLES** **9 Hours**

Process characteristics - Process equation, process load, process lag, self-regulation; Control system parameters - Error, variable range, control parameter range, control lag, dead time, cycling; Controller modes - Discontinuous controller mode, two position mode, multi-position mode, floating control mode. continuous control mode, proportional control mode, integral control mode, derivative control mode, composite control modes, PI control, PD control, PID control.

MODULE III **ANALOG CONTROLLERS** **9 Hours**

Introduction - Electronic controllers; Error detector; Single controller modes, Composite controller modes; Pneumatic Controllers - General features, mode Implementation.

MODULE IV **PROGRAMMABLE LOGIC CONTROLLERS** **9 Hours**

Evaluation of PLC, PLC architecture, basic structure; PLC programming - Ladder diagram, sequential flow chart; PLC communications and networking; Selection and installation of PLCs; Advantages of using PLCs; Application of PLCs to process control industries.

MODULE V **DISTRIBUTED CONTROL SYSTEM** **9 Hours**

Introduction - Overview of DCS, DCS software configuration; DCS communication, DCS supervisory computer tasks, DCS integration with PLCs and computers; Features of DCS; Advantages of DCS.

TOTAL: 45 HOURS

REFERENCES:

1. C.D. Johnson, ‘Process Control Instrumentation Technology’, PHI, 8th Edition, 2013.
2. S.K. Singh, ‘Computer Aided Process Control’, PHI, 2004.
3. Thomas E. Kissell, ‘Industrial Electronics’, PHI, 3rd Edition, 2003.
4. Noel M. Morris, ‘Control Engineering’, McGraw-Hill, 4th Edition, 1992.
5. Lukcas M.P., ‘Distributed Control Systems’, Van Nostrand Reinhold Co, Illustrated, 1986.
6. Huges T, ‘Programmable Controllers’, ISA press, 4th Edition IIlustrated, 2005.
7. A.K. Ghosh, ’Introduction to Instrumentation & Control’, PHI Learning Pvt. Ltd, 2004.
8. George C. Barney, ‘Intelligent Instrumentation’, Prentice Hall India.
9. https://nptel.ac.in/courses/108/105/108105088/

1903EE007	BIO-MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

MODULE I **BASIC CONCEPTS OF BIO MEDICAL INSTRUMENTATION** **9 Hours**

Terminology; Generalized medical instrumentation system; Measurement constraints; Biostatistics; Regulation of medical devices; Electrical safety in medical environment.

MODULE II **BIO POTENTIALS AND MEASUREMENTS** **9 Hours**

Electric activity and excitable cells; Functional organization of peripheral nervous system; EMG, ECG, EEG and recording systems; Bio-potential electrodes; Electrolyte interface; Polarization; Body surface recording electrodes; Microelectrodes; Electrodes for electric simulation of tissues; Practical hints for using electrodes.

MODULE III **BLOOD FLOW, PRESSURE, SOUND, CELL COUNTERS MEASUREMENT** **9 Hours**

Blood flow meters- Electromagnetic, Ultrasonic, Doppler and NMR blood flow meters; Cardiac output measurement- Indicator dilution methods and impedance technique; Measurement of blood pressure- Sphygmomanometer instrument based on Korotkoff sound, indirect measurement, automated indirect measurement and specific direct measurement techniques; Heart sound measurement- Stethoscope, phonocardiograph; Blood cell counters- Different methods, coulter counters, automatic recognition and differential counting of cells; Pulse oxymeters.

MODULE IV **THERAPEUTIC DEVICES** **9 Hours**

Cardiac pacemakers; Defibrillators; Hemodialysis; Ventilators; Infant incubators; Drug delivery devices; Therapeutic applications of the laser; Diathermy.

MODULE V **MEDICAL IMAGING SYSTEMS** **9 Hours**

X ray machine; Computer tomography; Ultrasonic imaging system; Magnetic resonance imaging system.

TOTAL: 45 HOURS

REFERENCES:

1. R. S. Khandpur “Handbook of Biomedical Instrumentation”, 2nd Edition, Tata McGraw Hill, 2005.
2. J.Webster, “Medical Instrumentation Application and Design”, 3rd Edition, Wiley & Sons, 2001.
3. Carr Joseph and Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, Asia, 2001.
4. Leslie Cromwell, “Biomedical Instrumentation and Measurements”, Prentice Hall, 2011

1903EE008	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

MODULE I **COAL BASED THERMAL POWER PLANTS** **9 Hours**

Energy Scenario- National and international context; Layout of modern coal power plant; Types of boiler- Super critical boilers, FBC boilers; Turbines; Condensers; Steam and heat rate; Subsystems of thermal power plants; Fuel and ash handling, draught system, feed water treatment.

MODULE II **HYDRO POWER PLANTS** **9 Hours**

Introduction to hydro power plant; Layout of dams- Types; Selection of water turbine, advantages and disadvantages; Selection of site for hydro power plant; Pumped storage hydro power plant.

MODULE III **DIESEL AND GAS POWER PLANTS** **9 Hours**

Types, open and closed cycle gas turbine; Work output and thermal efficiency; Inter cooling; Regeneration- Advantages and disadvantages; Diesel engine power plant; Component and layout.

MODULE IV **NUCLEAR POWER PLANTS** **9 Hours**

Basics of nuclear energy; Layout and subsystems of nuclear power plants; Nuclear fission and fusion; Types of reactor, working of nuclear reactors, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium- Uranium Reactor (CANDU), breeder, gas cooled reactors; Safety measures for nuclear power plants.

MODULE V **RENEWABLE ENERGY BASED POWER PLANTS** **9 Hours**

Typical layout, construction and working of wind, tidal, solar photo voltaic, solar thermal, geo thermal and biogas power plants.

TOTAL: 45 HOURS

REFERENCES:

1. P.K. Nag, "Power Plant Engineering", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., 2014.
2. M.M. El-Wakil, "Power Plant Technology", Tata McGraw-Hill Publishing Company Ltd., 2010.
3. Black &Veatch, "Power Plant Engineering", Springer,1996.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Standard Handbook of Power Plant Engineering", 3rd Edition, McGraw-Hill, 2004.
5. Godfrey Boyle, "Renewable energy" Oxford University Press in association with the Open University, 2004.
6. http://nptel.ac.in/courses/108108077/

1903EE009	POWER SEMICONDUCTOR DEVICES AND RECENT ADVANCEMENTS	L	T	P	C
		3	0	0	3

MODULE I INTRODUCTION **9 Hours**

Power switching devices overview- attributes of an ideal switch, application requirements, circuit symbols; power handling capability; SOA; Device selection strategy; On-state and switching losses, EMI due to switching; Power diodes- types, forward and reverse characteristics, switching characteristics, rating.

MODULE II CURRENT CONTROLLED DEVICES **9 Hours**

BJT's- construction, static characteristics, switching characteristics, negative temperature co- efficient and secondary breakdown, power darlington; Thyristors- Physical and electrical principle underlying operating mode, two transistor analogy, concept of latching, gate and switching characteristics, converter grade and inverter grade and other types, series and parallel operation; Comparison of BJT and Thyristor; Steady state and dynamic models of BJT and Thyristor.

MODULE III VOLTAGE CONTROLLED DEVICES **9 Hours**

Power MOSFETs and IGBTs- principle of voltage-controlled devices, construction, types, static and switching characteristics; Steady state and dynamic models of power MOSFET and IGBTs; Basics of GTO, MCT, FCT, RCT and IGCT.

MODULE IV FIRING AND PROTECTION CIRCUITS **9 Hours**

Necessity of isolation, pulse transformer, optocoupler; Gate driver circuit- SCR, MOSFET, IGBTs and base driving for power BJT; Over voltage, over current and gate protections; Design of snubbers. Heat transfer- conduction, convection and radiation, cooling, Heat sink- selection, types and design, mounting types.

MODULE V INTRODUCTION TO WIDE BAND GAP DEVICES **9 Hours**

WBG devices- overview, merits and demerits, applications, comparison with Si devices; Basics of SiC and GaN devices- static characteristics, dynamic characteristics, SiC MOSFET, GaN HFET.

TOTAL: 45 HOURS

REFERENCES:

1. B.W Williams, "Power Electronics Circuit Devices and Applications", Palgrave Macmillan
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications", 3rd Edition, Prentice Hall India, New Delhi, 2004.
3. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2008.
4. Mohan, Undeland and Robins, "Power Electronics – Concepts, Applications and Design", John Wiley and Sons, Singapore, 2000.
5. Bimal K. Bose, "Modern Power Electronics and AC Drives", 1st Edition, Pearson Education, 2015.
6. Fei (Fred) Wang, Zheyu Zhang and Edward A. Jones, "Characterization of Wide Bandgap Power Semiconductor Devices", IET Energy Engineering Series 128, 2018.
7. https://nptel.ac.in/courses/108/107/108107128/

1903EE010	MODERN POWER CONVERTERS	L	T	P	C
		3	0	0	3

MODULE I **SWITCHED MODE POWER SUPPLIES (SMPS)** **9 Hours**

DC power supplies and classification; Switched mode dc power supplies - With and without isolation, single and multiple outputs; Pump circuits - developed, transformer type and super lift pumps; Luo converters - positive, negative and double output; SEPIC converter; Voltage-lift converters and super lift converters -types and basic circuit operation; Closed loop control and regulation; Design examples on converter and closed loop performance.

MODULE II **AC-DC CONVERTERS** **9 Hours**

Switched mode ac-dc converters; Synchronous rectification; Single and three phase topologies; Switching techniques; High input power factor, reduced input current harmonic distortion, improved efficiency - with and without input-output isolation; Performance indices; Closed loop control and regulation; Design examples; Multi-converter systems - redundancy, reliability.

MODULE III **DC-AC CONVERTERS** **9 Hours**

Multi-level inversion - Concept, classification of multilevel inverters, principle of operation, main features and analysis of diode clamped, flying capacitor and cascaded multilevel inverters; Modulation schemes, waveforms and harmonic content; Comparison of topologies - Device stress, losses, component count and dc link voltage balancing; Z - Source converters; Active filters - topologies, operation and closed loop control.

MODULE IV **AC-AC CONVERTERS WITH AND WITHOUT DC LINK** **9 Hours**

Matrix converters - Basic topology of matrix converter; Commutation - current path; Modulation techniques - Scalar modulation, indirect modulation; Matrix converter as only ac-dc converter; Vienna Rectifier - Principle of operation, main features and analysis, types and applications; AC-AC converter with DC link - topologies and operation with and without resonance link, converter with dc link; Performance comparison of matrix converter with DC link converters.

MODULE V **SOFT-SWITCHING POWER CONVERTERS** **9 Hours**

Power electronic converters - Analysis and determination of power losses, loss reduction techniques; Soft switching techniques - ZVS, ZCS, ZVT, quasi resonance operation; Performance comparison; Hard switched and soft switched converters - ac-dc converter, dc-dc converter, dc-ac converter, ac-ac converter; Resonant dc power supplies - bidirectional power supplies; Introduction to concept of integrated topologies.

TOTAL: 45 HOURS

REFERENCES:

1. M.H.Rashid, “Power Electronics Handbook”, Academic press, NewYork, 2000.
2. Fang Lin Luo and Fang Lin Luo, “Advanced DC/DC Converters”, CRC Press, NewYork, 2004.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmierkowski, R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.
4. Issa Batarseh, “Power Electronic Circuits”, John Wiley and Sons, Inc, 2004.
5. Frede Blaabjerg and Zhe Chen, “Power Electronics for Modern Wind Turbines”, Morgan & Claypool Publishers series, United States of America, 2006.
6. Mukund R.Patel, “Wind and Solar Power Systems”, CRC Press, NewYork, 1999.
7. Jai P Agarwal, “Power Electronics: Converters, Applications, and Design”, 3rd edition, Prentice Hall, 2000.
8. https://nptel.ac.in/courses/108/107/108107128/

1701MGX01 PROFESSIONAL ETHICS

L	T	P	C
3	0	0	3

PREREQUISITE:

1. Basic understanding of business management
2. Basic understanding of human values

COURSE OBJECTIVES:

1. To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
2. To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
3. To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights
4. TohaveanadequateknowledgeaboutMNC"s,Business,Environmental,ComputerEthics, Honesty, Moral Leadership, sample Code of Conduct.
5. To use the engineering principles to update and maintain the technical skills.

Course Outcomes:

After completion of the course, Student will be able to

CO1 – Discuss about Engineering ethics by using various theorems(K2)
CO2 – Describe the role of engineering as social experimentation(K2)
CO3 – Explain the role of engineers for safety(K2)
CO4 –Discuss various responsibility and rights in professional ethics(K2)
CO5 – Discuss about various global issues and its impact in society(K2)

UNIT I ENGINEERING ETHICS 9 Hours

Senses of „Engineering Ethics"– Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9 Hours

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9 Hours

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Case Studies on Chernobyl, Bhopal MIC and Sterlite copper.

UNIT IV RESPONSIBILITIES AND RIGHTS 9 Hours

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9 Hours

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers –
Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR:

1. Case study on Hiroshima and Nagasaki

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi 2004
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

6. Nptel link: https://nptel.ac.in/courses/109/106/109106117/

1702EE701 PROTECTION AND SWITCHGEAR

L	T	P	C
3	0	0	3

PREREQUISITE :

1.Power system Analysis
2.Transmission and Distribution

COURSE OBJECTIVES:

1. Remember the fundamental protection schemes and the need of implying protection schemes.
2. Understand protection of different power system components such as transmission line, rotating machines, and
3. Study the different relay characteristics and their functionalities.
4. Understand and recognize circuit breakers: types, construction, performance and ratings.

Course Outcomes:

After completion of the course, Student will be able to
CO1 Explain the principle and operation of various protection schemes (K2)
CO2 Describe the function and characteristics of different types of relay(K2)
CO3 Describe the causes of abnormal operating condition of power system components(K2)
CO4 Outline the arc phenomenon and switching behavior of circuit breakers (K2)
CO5 Explain the classification of circuit breakers with testing standards(K2)

UNIT I INTRODUCTION TO PROTECTION SCHEMES. 9 Hours

Need for protection schemes; Fault conditions &calculations- Fault clearing process; Neutral grounding; Zones of protection; Digital protection schemes &applications.

UNIT II PROTECTIVE RELAYS AND RELAY CHARACTERISTICS 9 Hours

Importance of protective relaying; Electromagnetic relays- Over current, Differential, Distance, and Directional relays; R-X diagram; Digital relays, Microprocessor based relays.

UNIT III APPARATUS AND TRANSMISSION LINE PROTECTION 9 Hours

Protection of current transformer and potential transformer; Protection of generators and motors; Protection of transmission line; Bus bar protection schemes.

UNIT IV THEORY OF SWITCHING AND ARCING PHENOMENON 9 Hours

Current interruption ; Transient recovery voltage; Rate of rise of recovery voltage; Resistance switching; Current chopping; Interruption of capacitive current; Electric arc; Modes of arc extinction; Arc interruption theories.

UNIT V CIRCUIT BREAKERS 9 Hours

Air blast circuit breaker; Oil circuit breaker ;SF_6 circuit breaker; Vacuum circuit breaker; HVDC circuit breaker; Solid state circuit breaker; Rating and selection of circuit breakers; Testing of circuit breakers.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Voltage stability of electrical network
2. Digital computer aided protection and automation

REFERENCES:

1. BadriRam, Vishwakarma, "Power System Protection and Switchgear",Tata McGraw Hill, 2nd edition 2017.
2. Ravindra P.Singh, "Switchgear and Power system protection " PHI Learning Pvt. Ltd,2009
3. Bhuvanesh A Oza, Nirmal-Kumar C Nair, "Power system protection & switchgear", Tata McGraw-Hill Education,2010
4. B.Rabindranath andN.Chander, „PowerSystemProtection and Switchgear",NewAge International (P) Ltd., First Edition 2011.
5. Sunil S. Rao, "Switchgear and Protection", Khanna publishers, New Delhi, 13th Edition, Reprint 2012.

1702EE702 **POWER SYSTEM OPERATION AND CONTROL**

L	T	P	C
3	0	0	3

PREREQUISITE :

1. Transmission &Distribution.
2. Power system analysis.

COURSE OBJECTIVES:

1. To realize the basic operation of power system components.
2. To infer the economic operation of power system.
3. To summarize the various control methods & security schemes in power systems.

Course Outcomes:

After completion of the course, Student will be able to

CO1 Explain the principle and operation of various protection schemes(K2)

CO2 Make use of the importance of real power & frequency control in power system(K3)

CO3 Apply various methods of reactive power & voltage control in power system(K3)

CO4 Calculate the solution for unit commitment and least cost methodology for power generation(K3)

CO5 Describe the SCADA, EMS and various security schemes in power system(K2)

UNIT I **LOAD CHARACTERISTICS** **9 Hours**

Load and load duration curves; load forecasting; components of system load; classification of base load; forecasting of the base load by method of least square fit; necessity for regulation of system frequency and voltage; P-F and Q-V control structure.

UNIT II **REAL POWER - FREQUENCY CONTROL** **9 Hours**

Basics of speed governing mechanism and modeling; speed-load characteristics; load sharing between two synchronous machines in parallel; control area concept; LFC control of a single-area system- static and dynamic analysis; LFC control of two-area system.

UNIT III **REACTIVE POWER–VOLTAGE CONTROL** **9 Hours**

Fundamental characteristics of excitation system; types of excitation system; block diagram model of exciter system; analysis of AVR; generation and absorption of reactive power; methods of voltage control; application of FACTS Devices in Q-V control.

UNIT IV **UNIT COMMITMENT & ECONOMIC DISPATCH** **9 Hours**

Incremental cost curve; co-ordination equations with and without losses; solution by Lambda iteration; introduction to unit commitments; constraints on unit commitment; unit commitment methods.

UNIT V **COMPUTER CONTROL OF POWER SYSTEMS** **9 Hours**

Need for computer control of power systems; concept of energy control centre; functions ;system monitoring; data Acquisition and control; system hardware configuration; SCADA and EMS functions; state transition diagram showing various state transitions and control strategies.

Total: 45 Hours

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Implementation of PLC in automation Systems
2. Case studies of major international power blackouts and list out the cause and Effect of it.

REFERENCES:

1.Abhijit Chakrabarti, Sunita Halder, “Power System Analysis Operation and Control”, PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

2. Olle.I.Elgerd, “Electric Energy Systems theory - An introduction”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th Reprint, 2010.

3. Nagrath I.J. and Kothari D.P., „Modern Power System Analysis“, Tata McGraw-Hill, 4tn Edition, 2011.

4.HadiSaadat, “Power System Analysis”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

5. Allen. J. Wood and Bruce F. Wallenberg, “Power Generation, Operation and Control”, John Wiley & Sons, Inc., 2003.

6. http://nptel.ac.in/courses/108101040.

1702EE703 HIGH VOLTAGE ENGINEERING

L	T	P	C
3	0	0	3

PREREQUISITE :

1. Power system analysis
2. Transmission and Distribution

COURSE OBJECTIVES:

1. Understand transient overvoltage and the protection of high voltage apparatus
2. Understand high voltage generation and measurement techniques in high voltage engineering
3. Specify testing methods and standards in high voltage equipment testing

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO 1 Describe the fundamentals of over voltages, causes of over voltages and protection against over voltages(K2)
CO2 Explain the breakdown mechanism in gaseous, liquid, and vacuum dielectrics(K2)
CO3 Review the methods of generation of high voltages and high currents(K2)
CO4 Summarize the measurement techniques of high voltages and high currents (K2)
CO5 Infer the high voltage testing of electrical power apparatus like insulator, bushing, circuit breaker, isolater and transformer(K2)

UNIT I OVERVOLTAGE PHENOMENON 9 Hours

Electric field stresses; Estimation and control of electric stress; Natural causes of overvoltage; Lightning phenomenon; Mathematical modeling of lightning; Overvoltage due to switching surges; Surge voltage distribution and control.

UNIT II DIELECTRIC BREAKDOWN IN LIQUID, SOLID AND GASEOUS DIELECTRICS 9 Hours

Breakdown mechanisms in liquid dielectric-Liquid dielectrics used in practice; Various processes of breakdown in solid dielectrics -Solid dielectrics used in practice; Ionization process; Corona discharge; Gaseous breakdown in uniform, Non uniform fields; selection of gases as insulating materials.

UNIT III GENERATION OF HIGH VOLTAGE AND CURRENT 9 Hours

Generation of high DC voltage; Van de graff generator; Cascaded transformer ;Standard impulse wave shapes; Marx circuit generation of switching surges; Impulse current generation; Impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGE AND CURRENT 9 Hours

Measurement of HVDC current and voltage; Measurement of high AC and impulse voltages; Measurement of high current: Direct, alternating and impulse current; Cathode Ray Oscilloscope measurement technique for impulse voltage and current.

UNIT V HIGH VOLTAGE TESTING AND INSULATION COORDINATION 9 Hours

Principles of Insulation coordination; Testing of electrical apparatus- Insulators, Bushings, Circuit breakers , Cables ,Transformer ;Test standards ; Ratings of high voltage laboratories.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Power system transients
2. Indian testing standards of high voltage apparatus

REFERENCES:

1. S. Naidu and V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J. Kuffel, “High voltage Engineering fundamentals”, Newness Second Edition Elsevier, New Delhi, 2005.
3. Subir Ray, “An Introduction to High Voltage Engineering”, PHI Learning Private Limited, New Delhi, Second Edition, 2013.
4. C.L. Wadhwa, “High Voltage Engineering “New Age International, 2007.
5. Dieter Kind, Kurt Feser, “High Voltage test techniques”, Newness, 2001.

1703EE010 ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

PREREQUISITE :

1. Applied Chemistry
2. Electrical Machinery-I

COURSE OBJECTIVES:

1. To realize the importance of electric transportation systems
2. To understand the basics of electric vehicle components and configuration
3. To understand the various charging types, comfort and safety methods and application of electric vehicle in Smart grid

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 – Describe the importance and challenges of electric vehicles (K2)

CO2 – Discuss the energy storage system and battery technology in electric vehicles (K2)

CO3 – Infer about various charging system and starting system (K2)

CO4 – Explain the role of hybrid electric vehicle with its safety (K2)

CO5 – Discuss the emerging technologies and its benefits (K2)

UNIT I ELECTRIC VEHICLES 9 Hours

History of modern transportation; importance of different transportation development strategies to future oil supply; introduction to electric vehicles; history of hybrid and electric vehicles, social, environmental importance and key challenges of hybrid and electric vehicles; specifications of PHEVS, BEVS, EVS; plug-in hybrid vehicle characteristics; the future of electric vehicles.

UNIT II ENERGY STORAGE AND BATTERY TECHNOLOGY 9 Hours

Introduction to Energy Storage system; Battery Requirements for HEVs, PHEVs, and EVs; Types of batteries; Properties of batteries; Working principle and construction of lead-acid, nickel cadmium, nickel metal hydride, lithium ion Batteries; Maintenance and charging of batteries; Diagnosing lead-acid battery faults; Advanced battery technology; Developments in electrical storage; Case studies.

UNIT III CHARGING AND STARTING SYSTEMS 9 Hours

Requirements of the charging system; Charging system principles; Alternators and charging circuits; Diagnosing charging system faults; Advanced charging system technology; New developments in charging systems; Requirements of the starting system; Starter motors and circuits; Types of starter motor; Diagnosing starting system faults; Advanced starting system technology; New developments in starting systems; Case studies.

UNIT IV HYBRID ELECTRIC VEHICLE DRIVE TRAIN AND SAFETY 9 Hours

Requirement of drive train; Architecture of hybrid drive train; Sizing of components- Series configuration, Parallel configuration, parallel and series configuration; Security-Airbags and belt tensioners, Diagnosing comfort and safety system faults, Advanced comfort and safety systems technology; New developments in comfort and safety systems.

UNIT V EMERGING TECHNOLOGIES 9 Hours

Introduction-Electric Vehicle Supply Equipment, Smart vehicles in smart grid; Vehicle-to-grid technologies-Unidirectional and Bidirectional; Need of Charging Station Selection (CSS) server, Smart grid technologies-Applications / Benefits, Smart meter, Smart charger; Purpose and benefits; Ethics in road safety.

Total: 45 Hours

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Wireless charging of electric vehicles.
2. Monitoring and control of driverless electric vehicle.

REFERENCES:

1. M. Ehsani, Y. Gao, and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, Second Edition, 2009.
2. Tom Denton, “Automobile Electrical and Electronic Systems”, Elsevier Butterworth-Heinemann, Fourth Edition, 2011.
3. Ali Emadi, “Advanced Electric Drive Vehicles”, CRC Press, First Edition, 2014.
4. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
5. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, Second Edition, 2015.
6. NPTEL Course, “Historical Journey of Hybrids and Electric Vehicle”, by Dr. Praveen Kumar and Prof. S. Majhi, IIT-Guwahati.

1702EE751

POWER SYSTEM SIMULATION LABORATORY

L	T	P	C
0	0	2	1

PRE REQUISITE:

1. Power system analysis
2. Measurement and control laboratory

COURSE OBJECTIVES:

1. To develop simple C programs for the following basic requirements:
   a. Formation of bus admittance and impedance matrices and network solution.
   b. Power flow solution of small systems using simple method, Gauss-Seidel NR method.
   c. Economic Dispatch.
   d. Symmetrical and unsymmetrical faults
2. To acquire experience in the usage of standard packages for the following analysis / simulation / control functions.
   a. Simulation of Load-Frequency Dynamics and control of power system
   b. Transient stability simulation of single machine power system

Course Outcomes:

After completion of the course, Student will be able to

CO1 Understand and to solve the basic problems in power systems(K2)

CO2 Compute and model the transmission line parameters(K3)

CO3 Analyse the load flow in power systems(K3)

CO4 Model the power system dynamics components(K3)

CO5 Analyse the stability of the power systems (K3)

LIST OF EXPERIMENTS:

1. Calculation of per unit quantities
2. Formation of Y-bus and Z-bus matrices
3. Computation and modeling of transmission line parameters
4. Formation of reduced y_{bus} matrix by node elimination method
5. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method
6. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton Raphson Methods
7. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
8. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
9. Computation of line currents by symmetrical components
10. Economic Dispatch in Power Systems.
11. Symmetrical and unsymmetrical fault analysis
12. Study of EMTP, ETAP and MIPOWER software

Total: 30Hours

ADDITIONAL EXPERIMENTS:

1. Stability analysis of a power system using swing equation
2. Determination of load curve

REFERENCES:

1. J.P.Barret, P.Bornard and B.Meyer, “Power System Simulation”, Hapman and Hall publishers, 1996.
2. M.A.Pai, “Computer techniques in power system analysis”, New Delhi McGraw Hill Education (India) Private Limited,2014.
3. Harrold Klee and Randal Allen, “Simulation of dynamic systems with MATLAB”, CRC press, Third edition, 2017
4. https://onlinecourses.nptel.ac.in/

1702EE752	COMPUTER AIDED ELECTRICAL DRAWING LABORATORY	L	T	P	C
		0	0	2	1

PREREQUISITE :
1. Electrical Machinery -II
2. Transmission and Distribution

COURSE OBJECTIVES:
1. To gain basic knowledge of electrical drawings.
2. To learn about single line diagram of panels and switch boards.
3. To study about winding diagrams of dc motor and induction motor.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Draw the various symbols, notations and single line electrical drawings using software (K3)

CO2 Sketch the electrical machine assembly and winding diagram of induction motor(K3)

CO3 Draw the single line diagram of different panel boards and substation layout(K3)

CO4 Sketch the control and main circuit of motor starters(K3)

CO5 Draw the circuit diagram and simulate/test simple electrical and electronics circuits using simulation software(K3)

LIST OF EXPERIMENTS:

1. Draw the symbols used in electrical wiring.
2. Draw the single line diagram of single phase/three phase MCB distribution board.
3. Draw the single line diagram of typical MV panel.
4. Draw the single line diagram of lighting distribution board (LDB).
5. Draw the single line diagram of motor control center (MCC) panel.
6. Draw the electrical machine assembly drawing.
7. Draw the single line diagram of 110 KV/11KV receiving substation.
8. Draw the single line diagram of intercom arrangement in a multistoried building.
9. Draw the control and main circuit of motor starters.
10. Draw the winding diagram of single phase/three phase induction motor.
11. Draw the circuit diagram and simulate/test simple electrical/electronic circuits using simulation software.
12. Draw the layout diagram of any one power plant.

Total: 30 Hours

ADDITIONAL EXPERIMENTS:

1. Computer aided drawing of Heating Ventilation and Air Conditioning (HVAC) systems.
2. Computer aided simulation of simple electrical and electronics circuits using simulation software.

REFERENCES:

1. Sham Tickoo and Anurag, “AutoCAD 2013 for Engineers and Designers”, Dream tech press, New Delhi, 2013.
2. George Omura, “Mastering AutoCAD 2016 and AutoCAD LT 2016”, Sybex, New Delhi, 2016.
3. Muhammad H Rashid, “Introduction to PSpice using OrCAD for Circuits and Electronics”, PHI Learning, 3rd Edition, New Delhi, 2011.
4. K.M. Vishnu Murthy, “Computer-Aided Design of Electrical Machines”, BS Publications, Hyderabad, 2008.
5. M. Yogesh, B. S. Nagaraja, N. Nandan, “Computer Aided Electrical Drawing”, PHI Learning, First Edition, 2014.
6. https://thestylingbook.com/mastering-autocad-2013-and-autocad-lt-2013-free-related-books.html
7. Dr. T. Suresh Padmanabhan and Dr. V. Mohan, “Computer Aided Electrical Drawing Laboratory Manual”, 2018.

1703EE017	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Introduce the reactive power control techniques.
2. Educate on different FACTS devices with their specifications.
3. Provide knowledge on Coordinating emerging FACTS devices

COURSE OUTCOME

After completion of the course, Student will be able to

CO1 Discuss about various FACTS devices used in Reactive power control(K2)

CO2 Apply the characteristics of static Var compensator reactive power control applications(K3)

CO3 Make use of different modes of operation of TCSC for stability studies(K3)

CO4 Investigate the characteristics of voltage source converter based FACTS controllers(K3)

CO5 Correlate the interaction between various FACTS controller using linear control & genetic algorithms(K3)

UNIT I INTRODUCTION TO FACTS DEVICES 9 Hours

Reactive power control in electrical power transmission lines; Uncompensated transmission line - series compensation – Basic concepts of Static Var Compensator (SVC); Thyristor Controlled Series capacitor (TCSC); Unified power flow controller(UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9 Hours

Voltage control by SVC ; Advantages of slope in dynamic characteristics ;Influence of SVC on system voltage ; Design of SVC voltage regulator –Modeling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability ; Steady state power transfer ; Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9 Hours

Operation of the TCSC – Different modes of operation , Modeling of TCSC ; Variable reactance model ; TSC, TCR; Modeling for Power Flow and stability studies; Applications: Improvement of the system stability limit ; Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9 Hours

Static Synchronous Compensator (STATCOM) – Principle of operation, V-I Characteristics, Applications: Steady state power transfer, Enhancement of transient stability; Prevention of voltage instability; SSSC-Operation of SSSC and the control of power flow, Modeling of SSSC in load flow and transient stability studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS 9 Hours

Controller interactions - SVC – SVC interaction; Co-ordination of multiple controllers using linear control Techniques; Control coordination using genetic algorithms.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Modeling and simulation of power networks
2. Emerging trends in the interaction of FACTS devices.

REFERENCES:

1. R. Mohan Mathur and Rajiv K. Varma, “Thyristor Based FACTS Controller for Electrical Transmission Systems”, Wiley Interscience Publications, 2002
2. Narain G. Hingorani and Laszlo Gyugyi, “Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers, New Delhi, 2001.
3. K.R.Padiyar,” FACTS Controllers in Power Transmission and Distribution”, New Age International(P) Limited, Publishers, New Delhi, Second Edition 2016 Publication
4. PrabhaKundur, “Power System Stability and Control”, McGraw Hill, 2006.
5. Y.-H. Song and A.T. Johns “Flexible A.C. Transmission Systems (FACTS)”, IET Digital library.

1703EE018	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To design different power converters namely DC to DC and AC to AC converters For renewable energy systems.
2. To Provide knowledge about the stand-alone and grid connected renewable energy systems.
3. To analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.

COURSE OUTCOME

After completion of the course, Student will be able to

CO1 List the various renewable energy sources and its impacts like wind, ocean, biomass, fuel cell, and hydrogen and hybrid energy system(K2)

CO2 Describe the applications of various generators & power converters like PWM Inverters, Buck Boost converter, AC voltage controller and matrix inverter in solar and WECS(K2)

CO3 Explain the need of hybrid energy systems and its impacts with case studies(K2)

CO4 Explain the stand-alone and grid interactive issues related with solar & WECS. (K2)

CO5 Illustrate P&O, INC and Hybrid algorithms for solar system(K2).

UNIT I INTRODUCTION TO RENEWABLE ENERGY CONVERSION 9 Hours

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9 Hours

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS 9 Hours

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, And array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS 9 Hours

Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9 Hours

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1.Case study on MPPT

2. Case study of hybrid energy system.

REFERENCES:

1. Rashid .M. H "Power electronics Hand book", Academic press, third edition, 2009.
2. Godfrey Boyle, "Renewable energy: power for a sustainable future" Oxford university, third edition, 2012.
3. Ion Bolder, "Variable speed generators", Portland CRC press, second edition, 2015.
4. Rai. G.D, "Non-conventional energy sources", Khanna publisher, New Delhi, fifth edition, 2013.
5. Gray L. Johnson, "Wind energy system", prentice hall Inc. 1995.
6. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", Second edition, Wiley India Pvt. Ltd, 2012.
7. http://nptel.ac.in/courses/108105058/17.

1703EE019	ELECTRICAL ENERGY GENERATION UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To introduce the knowledge in Industrial applications of electric drives.
2. To introduce the energy saving concept by different ways of illumination and understand the different methods of electric heating and electric welding.
3. To study basic concepts and applications of solar photovoltaic power conversion system and comprehend the basic concepts of wind power conversion system.
4. To acquire the knowledge of tariff and economic aspects in power generation.

COURSE OUTCOME

After completion of the course, Student will be able to

CO1 - Recall the tractive effort for the propulsion of train, traction motors, characteristics of traction motor control, track equipment and collection gear.

CO2 - Explain the different light sources and various illumination systems for the lighting schemes

CO3 - Discuss the different methods of electric heating and types of electric welding schemes employed in industries.

CO4 - Explain the concept of solar radiation and Physical principles of the conversion of solar radiation into

CO5 - Describe the aerodynamic forces acting on the blade and basic components of a WECS.

CO6 - Discuss the performance of a flat plate collector and cylindrical parabolic concentrating collector.

UNIT I ELECTRIC DRIVES AND TRACTION 9 Hours

Fundamentals of electric drive: Types of electric drives - Merits of electric traction - choice of an electric motor - application of motors for particular services - traction motors - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear; Recent trends in electric traction.

UNIT II ILLUMINATION 9 Hours

Introduction - definition and meaning of terms used in illumination engineering; Classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps: Design of illumination systems - Indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting: energy saving lamps, LED.

UNIT III HEATING AND WELDING 9 Hours

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating –Types - Resistance heating - Arc furnaces - Induction heating - Dielectric heating - Electric welding – Types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV SOLAR RADIATION, SOLARENERGY COLLECTORS AND WIND ENERGY 9 Hours

Introduction - solar radiation at the Earth's surface - solar radiation geometry; estimation of average solar radiation- flat plate collectors - cover system - concentrating collector - advantages and disadvantages of concentrating collectors - parabolic concentrating collector – Introduction - basic principles of wind energy conversion - site selection considerations – basic components of a WECS (Wind Energy Conversion System) - Classification of WECS.

UNIT V ENERGY AND ECONOMIC ASPECTS OF GENERATION 9 Hours

Economic aspects of power generation; terms commonly used in system operation; various factors affecting cost of generation; load curves - load duration curves; connected load, maximum load, peak load, base load and peak load power plants, load factor, plant capacity factor, plant use factor, demand factor, diversity factor, cost of power plant, tariffs and types; comparison of site selection criteria, introduction to energy auditing.

Total: 45 Hours

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Solar rooftop PV system calculation for a home
2. Case study on Energy Auditing and Energy Conservation

References:

1. N.V. Suryanarayana, “Utilization of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B. Gupta, “Utilization Electric power and Electric Traction”, S.K. Kataria and Sons, 2000.
3. R.K. Rajput, “Utilization of Electric Power”, Laxmi Publications Private Limited., 2007.
4. C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt. Ltd, 2014.
5. H. Partab, “Utilization of Electrical Energy”, Dhanpat Rai and Co., New Delhi, 2004.